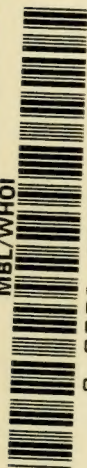




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Reports of
The Princeton University Expeditions
to Patagonia, 1896-1899

J. B. HATCHER, IN CHARGE

EDITED BY

WILLIAM B. SCOTT

BLAIR PROFESSOR OF GEOLOGY AND PALEONTOLOGY, PRINCETON UNIVERSITY



VOLUME III

ZOÖLOGY

~~PART II. BATRACHIANS AND REPTILES~~

~~BY~~

~~L. STEJNEGER~~

U. S. NATIONAL MUSEUM

PART III. THE FRESH WATER FISHES OF PATAGONIA AND AN EXAMINATION
OF THE ARCHIPLATA-ARCHHELENIS THEORY

BY

C. EIGENMANN

INDIANA UNIVERSITY

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PART III.

THE FRESH-WATER FISHES OF PATAGONIA AND
AN EXAMINATION OF THE ARCHIPLATA-
ARCHHELENIS THEORY.

BY

CARL H. EIGENMANN,

INDIANA UNIVERSITY.

PROFESSOR W. B. SCOTT,
PRINCETON, NEW JERSEY.

Dear Sir: I enclose the MS. of my report on the fishes collected by the late J. B. Hatcher in Patagonia. Instead of confining my report to the few specimens collected by Mr. Hatcher I have utilized, as far as possible, the knowledge gained from previous collections, and have dealt monographically with the fresh-water fishes of the area south of the line joining the mouth of the Rio Negro and Santiago, Chili. Ichthyologically this area constitutes a faunal unit sharply defined from temperate and tropical America to the north of it.

Since 1887 I have been busied more or less with the fresh-water fishes of South America, and the present opportunity seemed to me the best to use our knowledge concerning them to test the claims of the Archiplata-Archhelenis theory. This theory must stand or fall by the evidence of the fresh-water fishes. The task proved much more onerous than expected, but I feel amply repaid by the definite ideas gained by this review.

It seems quite certain: (*a*) that tropical America obtained the elements of its fauna in common with Africa before the Tertiaries, from some insignificant common ground inhabited by Cichlids, Characins, and Catfishes (Nematognaths) and perhaps types of wide distribution which remain only as relicts; (*b*) that tropical America has not been accessible and received few, if any, immigrants from other land areas since that time; but (*c*) that

the three types mentioned have undergone unparalleled adaptive radiation in the growing and metamorphosing continent, the Cichlids developing about 150 known species, the Characins 500, besides differentiating the Gymnotids, and the Catfishes, 500 or more species, distributed in several autochthonous families.

The grounds for all of these conclusions together with their corollaries you will find set forth in detail, all of which I hope will meet with your approval.

This report is divided therefore into a section dealing with The Fresh-water Fishes of Patagonia, a section dealing with the Archiplata-Archhelenis theory and a section listing all of the fresh-water fishes of South and Middle America.

I must at this place acknowledge the most courteous assistance received from Mr. Richard Rathbun and Mr. Barton A. Bean, of the United States National Museum ; Dr. G. A. Boulenger and Mr. C. T. Regan, of the British Museum ; Dr. Franz Steindachner, of the K. K. Museum of Vienna ; Mr. S. Henshaw, of the Museum of Comparative Zoölogy, and Dr. R. Gestro, of the Museo Civico di Storia Naturale, Genoa, Italy.

Respectfully submitted,

CARL H. EIGENMANN,

*Professor of Zoölogy, Indiana University, and Director of
the Indiana University Biological Station.*

THE FRESH-WATER FISHES OF PATAGONIA.

INTRODUCTION.

The interest in the Patagonian fresh-water fish fauna is entirely out of proportion to its diversity and centers largely in its origin. Only about twenty-nine species of fishes are known to live or enter the fresh waters south of the line joining Valparaiso and Bahia Blanca. These few species fall, according to their origin, into four distinct groups.

1. Immigrants from the sea are: (*a*) in the process of acclimatization, species of *Menidia* and *Atherinopsis*, or (*b*) may be looked upon as long established, species of *Percichthys* and *Percilia*. Members of *a* are found in all the rivers; members of *b* are found in the north chiefly, but reach the Santa Cruz river.

2. Immigrants from the fresh waters on the north: a very small overflow from the extremely rich fauna to the north and still retaining their generic affinity with northern forms. Here belong the species of the genera *Cheirodon* and *Astyanax*, which are very widely distributed in tropical South America and are not known to extend much south of the Rio Negro. Here also belongs *Hatcheria*, a southern modification of the widely distributed *Pygidium*.

3. Autochthons, or of doubtful origin. Here belongs the highly interesting *Diplomyste*, which is found on the northern border of Patagonia, but is not a derivative of the tropical American fauna. It is a relict of the original catfishes, in which the maxillary is still functional as a tooth bearer. Here belongs also *Nematogenys*, a catfish related to *Pygidium*. Like the members of group 2, these species are confined to the northern fringe of the Patagonian area.

4. There remain unaccounted for the members of the *Aplochitonidæ*, *Galaxiidæ* and *Petromyzonidæ*, chiefly of southern Patagonia. The two former Boulenger puts in his Haplomi, an order of odds and ends of fishes, containing such relicts as the *Percopsidæ*, *Amblyopsidæ* of North

America, *Kneriidae* of Africa, *Dalliidae* of Alaska and Siberia, and the dominant *Pæciliidae* of the tropical fresh waters, the *Esocidae* of the north temperate zone, and the *Scopelidae* of the deep sea. By Gill, on the other hand, they are placed in the order of Malacopterygii with the Clupeoids and Salmonoids.

Of the *Aplochitonidae* there are two genera, *Aplochiton* with an undetermined number of species in the Patagonian region, and *Prototroctes* with three species, one in Queensland, one in South Australia and one in New Zealand.

Of the *Galaxiidae* there are two genera, *Neochanna* (*apoda*) from New Zealand, where it frequently burrows in damp clay away from water, and *Galaxias*, with about 30 species from New Zealand, New South Wales, South Australia, Tasmania, Cape of Good Hope, southern South America and the Falkland Islands. The *Petromyzonidae* are found in all temperate fresh waters and seas, in both the northern and southern hemispheres.

The distribution of the two former families is of interest in connection with the theory of a former antarctic continent connecting the land masses in which they are found. In favor of a former land connection it may be argued, and with justice, that while these species descend to the sea, the probability that any pair of individuals should migrate from Cape Horn to New Zealand or vice versa is highly improbable. (This objection loses some weight if they spawn in the sea, as is reported.) There are no intermediate places that might be colonized and serve as new centers of distribution. It may further be urged that these species could readily have been distributed to their present homes by migration from stream to stream along a continuous coast line or on a land wave moving from one place to another. An obvious objection comes from the paucity of the forms with this peculiar distribution. If there was a continental mass connecting South America with New Zealand and Australia fit to be inhabited by fishes, there must have been an abundant and diverse fish fauna which has disappeared. If the antarctic continent depended entirely for its existence on the evidence from the distribution of the fresh water fishes, its existence would be very highly theoretical and precarious. Concerning the distribution of *Galaxias*, Boulenger says:

“The fact that certain species of *Galaxias* live both in fresh water and in the ocean suffices to explain the curious distribution of this small family without the necessity of appealing to the existence in the past of an

antarctic continent. It is probable that the Galaxiidae were formerly distributed as marine forms about the entire globe south of the tropic of Capricorn and that certain species on adapting themselves entirely to a life in freshwater have become localized in points as widely isolated from each other as those in which we know them now." See also the quotation under *Galaxias*, p. 271.

However, the evidence from other sources of a former land connection has become conclusive, and I am of the opinion that during the submergence of large parts of Patagonia during the late Pliocene the formerly abundant freshwater fauna became exterminated with the exception of those forms that were indifferently freshwater or marine.

The Petromyzonidae offer still another difficulty. There is no place on the American continents between the Mexican plateau and Central Chili that harbors any species of the family. The northern and southern species belong to distinct genera. At least two of the South American genera are peculiar, while two others are found in Australia and New Zealand.

A comparison of the Atlantic and the Pacific regions of Patagonia shows the two slopes to be largely inhabited by the same forms, a fact easily explained by the character of the species (anadromous or indifferently marine or aquatic) together with the continuous way by ocean and series of streams emptying at intervals between the Rio Negro and Santiago.

A comparison of the species inhabiting the southern part of the region from the Rio Santa Cruz south and the northern part from the Rio Santa Cruz to the north shows us that the southern part of Patagonia is inhabited by an extreme fauna limited to *Galaxias*, *Aplochiton*, *Geotria* and *Exomegas*.

To these are added on the north, on both sides, *Percichthys*, *Diplomyste* and *Pygidium*, and on the west alone, *Percilia*, *Nematogenys* and *Cheirodon*. On the east *Astyanax* and *Gymnocharacinus* appear before the La Plata fauna proper is reached. They are outliers of the largest of the South American families, the *Characidae*.

BOUNDARY BETWEEN THE BRAZILIAN AND PATAGONIAN REGIONS.

The definitive boundary between these regions has not been determined, since little is known of the fauna of the Rio Negro and nothing from the region about 500 miles wide extending north from a line connecting the

mouth of the Rio Negro with Santiago, Chili. No systematic collecting has been done in the Rio Negro, but the few specimens recorded from this region are, with the exception of *Astyanax*, Patagonian; on the other hand, the few specimens recorded from just south of Buenos Aires are Brazilian.

The southern boundary of the Brazilian fauna has been extended on the east by the La Plata-Paraguay river. The headwaters of this river, the Parana and especially the Paraguay, are in contact with the southern tributaries of the Amazon, and have opened a way for the southward migration of equatorial forms like members of the *Gymnotidæ*, the *Serrasalmoninæ* and the *Characinæ*, which have not succeeded in migrating so far south along the east coast, where there does not exist a continuous water way. (See the chapter on southeastern Brazil.) The distance which the La Plata-Paraguay has extended the tropical fauna can be measured by comparing the fauna of Buenos Aires, which is composed entirely of Amazonian types, with the fauna of the Rio Grande at the boundary of the United States, whose mouth is 10° nearer the equator and the Amazon than Buenos Aires, and only $6\frac{1}{2}$ per cent. of whose fauna is made up of equatorial types. This southward extension of the equatorial fauna was also facilitated by the entire absence of competitors. The entire fauna of the Parahyba near Rio de Janeiro is equatorial, while only 15 + per cent. of the Rio Panuco fauna in the same latitude in Mexico is equatorial, the rest being mostly intrusives from the north. Similar irregularities in the distribution of species are introduced in other parts of the globe, where a river has a north and south extent over different climates or regions, as in the case of the Nile.

On the Pacific slope one genus of tropical lowland forms, *Cheirodon*, reaches the southern limit of the Chilian plateau, and one mountain genus, *Pygidium*, reaches as far south as Santiago, Chili, and it is continued still further south as *Hatcheria*. The southern boundary of the northern fauna is here, so far as records show, the desert of Atacama. The southern boundary of the Brazilian fauna seems to be determined by climate and the means of ready migration.

The factors determining the northward extent of the Patagonian fauna are not so apparent. With the exception of *Geotria* and *Exomegas*, no Patagonian forms reach so far north as Buenos Aires on the Atlantic side; on the Pacific side the fauna in the latitude of Buenos Aires is still distinctly Patagonian.

SYNOPSIS OF THE FRESH-WATER FISHES OF PATAGONIA.

Class I. MARSIPOBRANCHII.

- = *Marsipobranhii* Bonaparte, Nuovi Annali delle Sci. Nat. t. 2, 1838 ;
Müller, Abhandl. K. Akad. Wiss. Berlin, 1844.
- < *Myzontes* Agassiz, Contrib. to Nat. Hist. of U. S., I, 187, 1857.
- = *Dermopteri* Cope, Proc. Acad. Nat. Sci. Phila. 1868, 256.
- = *Cyclostoma* Gegenbaur, Grundriss der vergl. Anat. 577, 1870.
- = *Cyclostomata* Schmidt, Handb. der vergleich. Anat. 6, Aufl. 259, 1872.
- = *Marsipobranhiates* Gill, Arrangement Fam. Fishes, IX, 25, 1872.

Skeleton cartilaginous ; skull imperfectly developed, not separate from the vertebral column ; no jaws, no limbs, no shoulder girdle, no innominales ; no branchial arches, gills in sacks, 6 or more ; nares single, median ; mouth suctorial, subcircular ; no bulbus arteriosus ; alimentary canal straight, simple, without cœcal appendages or pancreas ; an abdominal pore ; development with a metamorphosis.

Order I. HYPEROARTII.

- = *Hyperoartia* Müller, Abhandl. K. Akad. Wiss., Berlin, 1844.

Eel-shaped ; nasal duct a blind sack, not penetrating the palate ; gill-opening close behind the head, communicating with a common branchial passage which opens into the pharynx ; intestines with a spiral valve.

Family I. *PETROMYZONIDÆ*.

- = *Lampredini* Rafinesque, Indice d'Ittilog. Siciliana, 1810.
- = *Petromyzonidæ* Bonaparte, Nuovi Annali delle Sci. Nat. II, 133, 1838 ;
Jordan & Evermann, Bull. U. S. Nat. Mus. 47, 8, 1896.
- = *Petromyzontidæ* Girard, Expl. and Surv. for R. R. Route to Pacific Ocean, X, Fishes, 376, 1858.

General distribution : Temperate regions in both the northern and southern hemispheres, anadromous or landlocked.

Body eel-shaped, subcylindrical anteriorly, compressed behind ; the mouth nearly circular, suctorial, usually armed with horny teeth, or tooth-like tubercles which are simple or multicuspid, resting on papillæ ; those

immediately above and those immediately below the œsophagus more or less specialized ; eyes developed in the adult ; gill-openings 7, arranged in a row along the sides of the "chest"; nostril on top of head just in front of the eyes ; lips present, usually fringed ; dorsal fin more or less deeply divided by a notch, the posterior part commonly continuous with the anal around the tail ; intestines with a spiral valve ; eggs small.

KEY TO THE SOUTH AMERICAN GENERA OF PETROMYZONIDÆ.

- a.* Supraoral lamina median and undivided ; anus under the anterior part of the second dorsal ; second dorsal fin distinct from the caudal.
 - b.* Lingual teeth distinct and conic ; supraoral lamina transversely extended, quadricuspid ; infraoral crescent-like, sinuous or denticulate on the edge ; discal teeth numerous and in divergent series. 1. *Geotria*.
 - bb.* Lingual teeth three, standing on the same base, pointed and curved, the median smallest ; discal teeth in concentric series, the outer containing the largest teeth, about 24 on each side. 2. *Exomegas*.
- aa.* Two lateral supraoral laminæ entirely separate, triangular, each with three conic teeth ; infraoral lamina crescent-shaped, with about nine acute conical cusps ; discal teeth in somewhat distant series, radiating from the center, those of a series more or less confluent ; lingual teeth serrate, in two pairs ; anus under the posterior part of the second dorsal ; posterior dorsal continuous with the caudal. 3. *Caragola*.

I. GEOTRIA Gray.

(Plate XXX.)

> *Geotria* Gray, Proc. Zool. Soc. London, 1851, 238, pl. IV, fig. 3, and pl. V ; id. List Spec. Fish. Brit. Mus. I, 142, pl. 1, fig. 3 and pl. 2, 1851 (*australis*).

> *Velasia* Gray, Proc. Zool. Soc. London, 1851, 239, pl. IV, fig. 4 ; id. List Spec. Fish. Brit. Mus. I, 143, pl. 1, fig. 4, 1851 (*chilensis*).

= *Velasia* Günther, Cat. Fish. Brit. Mus. V, 508, 1870 ; Gill, Proc. U. S. Nat. Mus. V, 524, 1882 (*chilensis*).

Macrophthalmia Plate, Sb. Ges. Naturf. Fr. Berlin, 1887, 137 (*chilensis*).

Type: *Geotria australis* Gray.

Distribution: Temperate regions of the southern hemisphere.

Distinguished from *Exomegas* by having distinct lingual teeth.

Plate distinguishes between the three species of this genus as follows:

- a.* Labial teeth numerous and close together.
 - b.* Outer lingual tooth very large, with 2 large and 1 median short point on a low base ; two small inconspicuous inner lingual teeth. Supraoral plate plainly denticulate ; a small gular sack in the ripe ♀. Australia, New Zealand and South America. 1, *chilensis*.

- bb.* Outer lingual tooth with 3 uniform points; two larger, inner, lingual teeth each larger than the outer; supraoral plate smooth or denticulate; no gular sack. New Zealand, Tasmania. *stenostomus*.¹
- aa.* Labial teeth wide apart; outer lingual tooth large with two large points on a high base; 2 inconspicuous lingual teeth; supraoral plate smooth or nearly smooth; an enormous gular sack even in immature specimens. Australia and South America. *2, australis.*

I. GEOTRIA CHILENSIS (Gray).

[†] (Plate XXX, Figs. 1 and 1a.)

Velasia chilensis Gray, Proc. Zool. Soc. London, 1851, 239, pl. iv, fig. 4 (Chili, in fresh water); id. List. Spec. Fish. Brit. Mus. 143, pl. i, fig. 4, 1851; id. Ann. & Mag. Nat. Hist., XIII, 63, 1854; Philippi, Wieg. Arch. 1863, 207, pl. x, fig. a (Valdivia).

Geotria chilensis Günther, Cat. Fish. Brit. Mus., XIII, 509, 1870; Hutton, Trans. New Zealand Inst., V, 271, 1872 and XIII, 216, 1875; Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., XIV, 24, 1891; Gill, Mem. Nat. Acad. Sci. Washington, VI, 110, 1893; Berg, An. Mus. Nac. Buenos Aires, IV, 122, 1895 (Rio de la Plata); Delfin, Catalogo de los Peces de Chile, 13, 1901. Plate, Zool. Jahrb. Suppl. V, 660, 1902 (Australia; New Zealand; Valdivia; Puerto Montt.).

Macrophthalmia chilensis Plate, Sb. Ges. Naturf. Fr. Berlin, Oct. 19, 1897, 137. (Source of the Rio Maullin from the Lago Llanquihui.)

Habitat: Streams of Chili and Argentina; New Zealand and Australia.

"Outer lobes of the maxillary dental lamina broad with a sharp convex edge, inner narrow and pointed; mandibular lamina crescent-shaped, with numerous obtuse points; suctorial teeth in numerous series, close together; a series of larger, broad, scale-like teeth round the mandibular lamina; suctorial disk not dilated, circular; first and second dorsal fins widely separate from each other; back greenish; sides and abdomen silvery." Günther.

No specimens of this species were obtained by Hatcher, nor has it been actually reported from any of the streams of Patagonia. Its presence in New Zealand, Chili and La Plata makes its occurrence in Patagonian waters certain. The fact that it has not been taken is easily accounted for by its anadromic habit. So few specimens of the lampreys are known that nothing is definitely settled concerning the generic or specific identity. It is not improbable that Berg's *Geotria chilensis* is in reality an *Exomegas*.

¹ Plate XXX, fig. 2.

2. GEOTRIA AUSTRALIS Gray.

(Plate XXX, Figs. 3 and 3a.)

Geotria australis Gray, Proc. Zool. Soc. 1851, 238; id. List Spec. Fish Brit. Mus. 142, pl. ii; 1851 (Inkarpinki River); Günther, Cat. Fish. Brit. Mus. VIII, 508, 1870; Plate, Zool. Jahrb. Suppl. V. 668, 1902 (Valdivia, Chili; King George's sound, Australia).

Habitat: Australia and Chili.

No specimens of this species were obtained by Hatcher. The following is a description based on the type specimen.

"Skin of the throat very lax, forming a large pouch; maxillary lamina thin, crescent-shaped, with four sharp teeth, the middle pair of which are only half as broad as the outer. Mandibular lamina very low, slightly sinuous; suctorial teeth in numerous series, rather distant from one another, aniscuspid; only those nearest to the mouth somewhat larger, the others small; only one transverse series of very small teeth between the mandibular lamina and the posterior lip, which is beset with numerous broad, leaf-like fringes, as in the remainder of the margins of the disk; suctorial disk subtriangular with the lateral lobes very broad; first and second dorsal fins rather widely separated from each other." Günther.

2. EXOMEGAS Gill.

Exomegas Gill, Proc. U. S. Nat. Mus., V, 524, 1882 (*macrostomus*).

Type: *Petromyzon macrostomus* Burmeister.

Günther (Cat. Fish. Brit. Mus. VIII, 505, 1870) was the first to recognize the aberrant nature of this genus. He says: "The following species would appear to be the type of a distinct genus, but it will be better to leave its creation to an ichthyologist who will be able to characterize it from an autopsy of examples." The genus was named by Gill, *l. c.* It is not improbable that it is synonymous with *Geotria*. Smitt says on this point:

"Cette structure de la ventouse et de la bouche, comparée aux descriptions et aux figures des *Geotria* et des *Velasia* chez les auteurs, ne nous donne aucun signe de divergence de forme mais bien de développement. C'est un plus-ou-moins du développement des cartilages et de la substance cornée du même type. Si l'on place les espèces décrites dans

l'ordre suivant: *Velasia chilensis*, *Geotria australis*, *Exomegas macrostomus*, et enfin notre exemplaire, on voit une série continue de développement de ce plus-ou-moins. Les termes de cette série, s'ils se trouvent constants à des différents locaux, peuvent naturellement être regardés comme des espèces distinctes ou des formes locales—c'est là une question de convenance—mais certainement ils ne méritent pas d'être des types génériques."

Larvæ very similar to those of *Petromyzon* but with more than 80 preanal myomeres; a triangular nasal opening; dentition simple, a lingual tooth with 3 points, of which the median is very small; suctorial teeth radially arranged, papillary; no median, supraoral or infraoral teeth; mouth bordered by cutaneous lamina; dorsals remote.

Distribution of the Species: Gallegos to Rio de la Plata.

a. Back rounded; a gular pouch.

3. *macrostomus*.

aa. Back with a flattened area bordered by two dermal folds, merged behind and continued in front on the snout; no gular pouch.

4. *macrostomus gallegensis*.

3. EXOMEGAS MACROSTOMUS (Burmeister).

Petromyzon macrostomus Burmeister, Anal. Mus. Buenos Aires, 1868; Act. Soc. Paleont. XXXVI; Günther, Cat. Fish. Brit. Mus. VIII, 506, 1870.

Exomegas macrostomus Gill, Proc. U. S. Nat. Mus. V, 524, 1882; id. Science XXIII, 30, Jan. 19, 1894; id. Proc. U. S. Nat. Mus. XVII, 110, 1894.

Geotria macrostomus Berg, Anales del Museo de La Plata I, 2, plate 1, 1893 (Island of Flores, near Montevideo).

This species, if distinct from the variety *gallegensis*, is known from but two specimens; one, 40 cm. long, described by Burmeister was found alive in the Calle de Mexico in Buenos Aires in 1867, immediately after a heavy rain; the second, 44 cm. long, was obtained in 1890 and was recorded by Berg. If distinct from the Gallegos specimens, this species is extralimital.

"No teeth in the circumference of the mouth; outer row of the 10-11 concentric series largest, about 24 on each side; gular sack large." Berg.

4. EXOMEGAS MACROSTOMUS GALLEGENSIS (Smitt).

(Plate XXX, Figs. 4 and 4a.)

Geotria macrostoma gallegensis Smitt, Bihang Till K. Sv. Vet. Akad. Handl. Band 26, afd. iv, No. 13, 23 (Rio Gallegos and its tributaries, Rio Ruben and Rio Turbio).

This variety is known from a single adult individual and several larvæ. It differs from *macrostomus* chiefly in the flat dorsal region.

3. CARAGOLA Gray.

< *Caragola* Gray, Proc. Zool. Soc. London, 1851, 239, pl. iv, fig. 5; id. List Spec. Fish Brit. Mus., I, 143, pl. 1, fig. 5, 1851; Gill, Proc. U. S. Nat. Mus., V, 525, 1882 (*lapicida*).

< *Mordacia* Gray, Proc. Zool. Soc. London, 1851, 239, pl. iv, fig. 6; id. List Spec. Fish Brit. Mus., I, 143, pl. 1, fig. 6, 1851.

= *Mordacia* Günther, Cat. Fishes Brit. Mus., VIII, 8, 507, 1870; Plate, Zool. Jahrb. Suppl., V, 1902, 654.

Type: *Caragola lapicida* Gray.

This genus is considered but a subgenus of *Geotria* by Smitt, as a distinct genus by Günther, and the type of a distinct family by Gill.

Second dorsal continuous with the caudal; two pairs of serrated lingual teeth; maxillary dentition consisting of two triangular groups, each with three conical acute cusps.

Plate considers three species as valid which he distinguishes as follows:

- a. Outer lingual tooth a broad transverse plate with numerous points; eyes small.
 - b. Wreath of inner labial teeth closed in the middle in front with three single pointed teeth.
 - 5. *mordax*.
 - bb. Wreath of inner labial teeth closed in the middle in front with one single pointed tooth.
 - 6. *lapicida*.
- aa. Outer lingual tooth triangular, with but two retrorse hooks. Eyes relatively large.
 - 7. *acutidens*.

5. CARAGOLA MORDAX (Richardson).

(Plate XXX, Fig. 5.)

Petromyzon mordax Richardson, Voy. Erebus and Terror, Fish., pl. 38, 1845 (Tasmania).

Mordacia mordax Gray, List Spec. Fish. Brit. Mus., 144, pl. 1, fig. 6, 1851 (copied); Günther, Cat. Brit. Mus., VIII, 507, 1870 (Valparaiso; Tas-

mania); Steindachner, Zool. Jahrb. Suppl., IV, 334, 1898 (Tumbes); Delfin, Catalogo de los Peces de Chile, 13, 1901 (Rio Tucape and Puerto Montt); Plate, Zool. Jahrb. Suppl., V, 654, 1902 (Murray River).

Habitat: Coastwise streams of Chili, south to at least Puerto Montt (Tasmania).

"Mandibular lamina crescent-shaped, with about nine acute conical cusps, three of which are larger than the others; suctorial teeth in somewhat distant series, radiating from the center; the teeth of the series between the mandible and posterior lip as numerous as those of the other series but rather more confluent; anterior labial teeth converging and confluent behind, each tooth of the posterior pair like one half of an elongated oval; suctorial disk elliptic, with a free lip behind." Günther.

6. CARAGOLA LAPICIDA Gray.

(Plate XXX, Fig. 6.)

Caragola lapicida Gray, Proc. Zool. Soc., 1851, 239 (Valparaiso). List Spec. Fish Brit. Mus., 143, pl. I, fig. 5.

Mordacia lapicida Plate, l. c., 654 (Tumbes, Chili).

Petromyzon anwandteri Philippi, Wieg. Arch. 1863, 207, tab. X, fig. 6 (Valdivia).

Habitat: Chili.

7. CARAGOLA ACUTIDENS (Philippi).

(Plate XXX, Fig. 7.)

Petromyzon acutidens Philippi, Ann. & Mag. Nat. Hist., XVI, 1865, 221.¹

Mordacia acutidens Plate, l. c. 657.

Habitat: Chili.

Class II. PISCES.

<Pisces Artedi; Genera Piscium 1738.

<Pisces Linnæus Sytēma Naturæ ed. X, I, 239, 1758.

=Pisces Müller, Abhandl. K. Akad. Wiss. Berlin, 1844.

¹ This is the translation of an article credited to "Wieg. Arch. 1864, 107." It is not found in the place cited.

Superorder OSTARIOPHYSI.

Ostariophysi Sagemehl, Morph. Jahrbuch X, 1-120, plates I and II.

Anterior four vertebræ coössified, much modified; frequently a chain of four ossicula auditus forming the Weberian apparatus attached to the anterior vertebræ and connecting the air-bladder with the auditory apparatus; air-bladder connected with the alimentary canal by a duct. Parietals separating the frontals from the supraoccipital or fused with the latter. Shoulder girdle suspended from the skull by a long post temporal; meso-coracoid arch well developed; opercle well developed. Ventrals abdominal, without spines.

The fishes belonging to the families making up the order or superorder of Ostariophysi are the dominant forms in the fresh waters of the world. They fall naturally into two groups or orders:

I. Nematognathi with no subopercle or symplectic bone; the supraoccipital and parietals coössified; the maxillary usually without teeth and reduced to form the core of a variously developed barbel; no scales.

II. Plectospondyli, a less solid group; with subopercle and symplectic bones and with a well formed maxillary and frequently with teeth.

Of these the Nematognathi are found both in the northern and southern hemispheres and have also become inhabitants of the sea.

The Plectospondyli fall into three groups of families, those related to the *Cyprinidæ*, confined chiefly to the northern hemisphere but overflowing into northern Africa, those related to the *Characidæ* inhabiting Africa and South America but overflowing into Central America and Mexico, and those related to the *Gymnotidæ* and confined to tropical America.

Of the 1,200 or more species of fresh-water fishes recorded from tropical America, about 1,000 belong to the Ostariophysi; in round numbers about 500 of these belong to the Nematognathi and another 500 to the Plectospondyli. Of the African fresh-water fishes a much smaller per cent. are Ostariophysi.

Of this vast array of American species, very few are found within the boundaries of the region under consideration and most of these barely cross its northern border.

Order II. NEMATOGNATHI.

Nematognathi Gill, Fishes of East Coast, 1870.

The following opinions expressed several years ago in a then obscure and now extinct journal are still, in part, pertinent and are repeated with a few verbal changes.

Not many fossils of this order have been found, and those which have been discovered do not help us materially in determining the interrelations of the higher groups.

The date of the differentiation of the orders of the *Ostariophysi* is uncertain. Silurinae, Bagarinae and Pimelodinae were separated as early as the beginning of the Tertiary, and as these subfamilies are quite remote from the most primitive living nematognathid, the Nematognathi must extend into the Secondary period.

The Nematognathi reach their highest development in the neo-tropics, where they constitute forty per cent. of the entire freshwater fish fauna. Most of the families, sub-families and genera now inhabiting this region have undoubtedly originated here. In most of the families the maxillary bone is a mere vestige and serves only as a support for a highly specialized dermal appendage, the maxillary barbel. So greatly has this been modified, even in its development, that Ryder seriously questioned whether the basal bone of the maxillary barbel in the North American cat-fishes is in reality the vestige of a maxillary. No doubt need, however, be entertained on that score, since in *Diplomyste* the basal bone of the short primitive maxillary barbel is a functional dentiferous maxillary.

The comparative development of the maxillary is, then, an excellent guide to the determination of the rank any family is to occupy in the system.

Other structures valuable in this respect are the different barbels so highly developed in some forms. Of the development of the barbels of *Ictalurus albidus*, Ryder says:

"The remarkably developed barbels of the embryos of the species make their appearance very early, especially the maxillary pair; these appear on the second day. . . . The barbels on the lower jaw do not appear till the fourth day of the development is completed. . . . The last of all to be developed is the nasal pair, . . . (which) does not appear until the seventh day."

In *Diplomyste* only short maxillary barbels are developed, and, as stated above, the maxillary is dentiferous and forms the mouth border above. It therefore has its barbels less specialized than the remaining families, while its maxillary is more generalized and resembles that of other fishes. The *Diplomystidæ* may therefore be considered the most primitive of the Nematognathi. At present this family is restricted to the fresh waters of central Chili and northern Patagonia.

The next important factor to be considered is the relative development and specialization of the air-bladder and Weberian apparatus. In the *Bunocephalidæ* and the *Siluridæ*, with the exception of the *Ageneiosinæ*, the air-bladder is large and lies below the coössified vertebræ. In the remaining South American families the air-bladder has been split into lateral halves, and, with the corresponding bones of the Weberian apparatus, has been enclosed in a bony capsule.

In the *Bunocephalidæ* there are no indications of any approach to the enclosed air-bladder, and indeed this family shows little resemblance to the remaining families. It was early differentiated from the descendants of the *Diplomystidæ*, but not before the maxillary had become quite vestigial. Two subfamilies have become differentiated; they differ chiefly in the number of vertebræ in the tail and the number of anal rays. This family inhabits the La Plata basin, the Amazon and the South American rivers to the north of it.

The cosmopolitan family, *Siluridæ*, is composed of a large number of subfamilies, seven of which are American, or have representatives in America. They vary considerably from the most generalized Tachisurinæ, which most resemble the *Diplomystidæ*, to the Doradinæ and Ageneiosinæ, in which last we observe an approach to the conditions obtaining in the families with closed air-bladders.

As is intimated above, the Tachisurinæ are the lowest of the living *Siluridæ*. The members of this subfamily are mostly marine, and from it have, in all probability, been derived the remaining subfamilies. Some members of the Tachisurinæ have only the maxillary barbels developed, while in others the mental barbels have been added.

From the Tachisurinæ have unquestionably been derived the Callophysinæ and Pimelodinæ, which differ from each other in dentition. Both these subfamilies are neotropical in their distribution, the Callophysinæ being found in the Amazon and northward, the Pimelodinæ in the whole

region from the La Plata to Mexico. One of the chief features modified in passing from the Tachisurinæ to the Pimelodinæ is the space between the anterior and posterior nares. In the Pimelodinæ the barbels obtain their greatest specialization. The nasal barbels are, however, not developed before the Bagrinæ are reached, to which all the North American species belong.

From the Pimelodinæ have also been derived the Doradinæ, in which dermal ossifications first make their appearance, although minute plates are noticed along the anterior portion of the lateral line of *Platystomatichthys sturio* (Pimelodinæ).

In the Doradinæ and the succeeding subfamilies of *Siluridæ* the Weberian apparatus varies greatly and the whole group seems to be in a state of unstable equilibrium.

In the Ageneiosinæ appears for the first time the great reduction and splitting into lateral halves of the air-bladder. From the Ageneiosinæ were undoubtedly directly derived the Hypophthalmidæ.

From the primitive Ageneiosinæ and Auchenipterinæ have evidently been derived, as a lateral offshoot, the *Pygidiidæ*, of which the Cetopsinæ retain the most ancestral traits. In this family nasal barbels again appear. Some members of Stegophelinæ have lost the habit of free swimming and live as commensals or parasites in the gill-cavity of large species of the *Siluridæ*.

The three remaining families were, by Dr. Günther, united in one of his inferior groups, Hypostomatina. They have little external resemblance to the *Siluridæ*.

The *Callichthyidæ* have two series of smooth plates covering the sides, while the *Loricariidæ* have several series of rough plates. The teeth and dentiferous bones of the latter have also been considerably modified. The *Argidæ* are dwarfed forms inhabiting high mountain streams. They are naked but otherwise similar to the mailed *Loricariidæ*.

Family II. *DIPLOMYSTIDÆ*.

= *Diplomystidæ* Eigenmann, Zoe, Vol. I, 14, 1890.

Air-bladder well developed, simple or with transverse constrictions, lying free in the abdominal cavity. Mouth terminal, teeth incisor-like and villiform; intestines short, arranged in longitudinal folds. Body naked. Diaphragm membranaceous. Tip of scapular process touching basioccip-

ital. Dorsal short, confined to the abdominal portion of the vertebral column. Opercle well developed and movable; adipose fin present; occipital process not forming a bony bridge from the occipital to the dorsal plate. Caudal vertebræ not compressed, the neural spines simple, spine-like. Maxillary well developed, provided with teeth and forming the sides of the jaw; nares approximated; gill membranes somewhat joined, but free from the isthmus. A single genus.

4. DIPLOMYSTE.

Diplomyste Dumeril, Ichthyol. Analyt., 487, 1856 (*papillosus*).

Diplomystes Bleeker, Nederl. Tijdschr. Dierkunde, I, 92, 1863 (*papillosus*).

Diplomystax Günther, Cat. Fish. Brit. Mus., V, 180, 1864 (*papillosus*).

The distinctive character of this genus is the development of the maxillary bone. It forms the sides of the mouth and carries a very narrow band of teeth. No mental barbels; maxillary barbels thick, compressed at the base. Occipital process not visible externally; no bony orbit. Skull with two nearly parallel median ridges above. Fontanel extending to the base of the occipital process, with a rather broad interruption behind the eyes. A single species.

Habitat: Chili, near Valparaiso and Santiago.

8. DIPLOMYSTE PAPILLOSUS (Cuvier & Valenciennes).

(Plate XXXI, Figs. 1, 1a and 1b.)

Molina "Hist. Nat. Chile, 199, No. 9."

?? *Silurus chilensis* Linnæus, Syst. Nat. Ed. XIII, 1359, 1788 (Chili).

?? *Pimelodus chilensis* Lacépède, Hist. Nat. Poiss., V, 114, 1803 (Freshwaters of Chili).

Arius papillosus Cuv. & Val. Hist. Nat. Poiss., XV, 118, pl. 431, 1840 (Valparaiso; Santiago); Gay, Hist. Chile, II, 305, pl. fig. 1, 1848 (Chili) Philippi, MB. Ak. Wiss. Berlin, 1866, 710 (Chili).

Diplomystax papillosus Günther, Cat. Fish. Brit. Mus., V, 180, 1864 (Chili).

Diplomystes papillosus Eigenmann & Eigenmann, Proc. Cal. Acad. 2d ser. vol. I, 1888, 149 (Rivers of Santiago).

Arius carcharias "Leybold, Anales de la Universidad de Chili, 1859 (Chile)"; Philippi, MB. Akad. Wiss. Berlin, 1866, 711 (Chili).

Arius villosus Philippi, l. c., 712 (Santiago).

Arius squalus Philippi, l. c., 713 (Santiago).

Arius micropterus Philippi, l. c., 713 (Santiago).

Arius synodon Philippi, l. c., 713 (Santiago).

Habitat: Central portion of Chili.

The numerous species of Philippi seem to be based on individual differences. The seventh dorsal ray is always divided to near its base, and in one of the specimens examined by me there are eight dorsal rays.

Slender, terete forward, compressed toward the tail; the width, below the dorsal spine, equals the depth. Head short and blunt, somewhat pointed in young, the profile strongly decurved in front; head entirely covered with a layer of muscle and skin, the surface of the bones irregular, rugose, the interorbital portion flattish, postorbital portion with two nearly parallel median ridges, fontanel between the two median ridges, extending from the occipital process to in front of the eyes, with a broad bridge behind the eyes. Occipital process a deep but short crest.

Eye small, circular, 3 in snout, little more than 1 in the interorbital, 3 in the interocular, 7_2 in the head.

Nostrils close together, with a membrane around the entire margin forming an 8-shaped figure, the portion of the membrane separating the nasal openings highest.

Maxillary barbel broad and flattened at its base, scarcely reaching the base of the pectoral.

Snout sometimes long and pointed, usually rounded, projecting considerably beyond the lower jaw. Lips thick and strongly papillose. Maxillary bones reaching to below the eye, $2\frac{2}{3}$ in the head. The anterior half of the maxillary consists of a slender peduncle bearing two series of teeth; the posterior portion is flattened and about three times as wide as the anterior portion. Premaxillaries with a crescent-shaped patch of teeth, the outer four or five series compressed, incisor-like; teeth of the inner series very much smaller, not incisor-like. Vomer with two oval patches of large conical teeth, the patches becoming united with age. Teeth of the lower jaw compressed, incisor-like; the band deep in front tapering rapidly to the rictus.

Gill-membranes usually separate to below the eye, entirely free from the isthmus. Gill-rakers 5 + 8. Pseudobranchiæ well developed, not covered by a membrane.

Skin covered with minute cirri or papillæ, which are especially conspicuous over the humeral region and head, the tail sometimes smooth.

Distance of dorsal fin from tip of snout $2\frac{3}{5}$ – $2\frac{4}{5}$ in the length, the spine stout and smooth, $1\frac{1}{2}$ – $1\frac{2}{3}$ in head. Distance of the adipose fin behind the dorsal about equal to the length of the adipose fin or one-half longer, 5–6 in the length.

Caudal emarginate, with numerous, short, accessory basal rays.

Free margin of the anal straight or slightly convex, the fifth ray highest, about $1\frac{1}{2}$ in the head, rapidly decreasing to the last ray, which is about half the height of the fifth.

Pectoral spine very strong and with a leathery prolongation; height of the spinous portion $1\frac{2}{3}$ –2 in the head; outer margin of the spine smooth, inner margin with strong, recurved teeth along its entire length.

Bases of all the fins, lower part of head, suborbital regions and opercles and a median line on the back purplish; rest of body and fins yellowish and under the lens dark.

Head 4 – $4\frac{1}{2}$; depth $4\frac{1}{4}$ – $5\frac{1}{2}$; Br. 7; D. I, 7 or 8; A. 9–12.

No specimens were collected by Hatcher and the above description is based on the material in the Museum of Comparative Zoölogy at Harvard University.

Family III. *PYGIDIIDÆ*.

> *Siluroidei trichomycteriformes* Bleeker, Nederl. Tijdschr. Dierk. I, 112, 1863.

> *Siluridæ opisthopteræ* Günther, Cat. Fish. Brit. Mus. V, 4, 1864.

> *Siluridæ branchicolæ* Günther, l. c.

> *Trichomycteridæ* Gill, Arrangement of Families of Fishes, 19, 1872.

= *Pygidiidæ* Eigenmann & Eigenmann, Am. Nat. July, 1888, and South Amer. Nematognathi 316, 1890.

Distribution of the species: East and west slopes from Colombia to La Plata and along the Andes to Patagonia.

Air-bladder vestigial, part on either side of the coalesced vertebræ and enclosed in a capsule formed by the lateral processes of the coalesced vertebræ only; the external orifice of the air-bladder capsule as in *Hypophthalmidæ*, its anterior side closed. Adipose fin none; dorsal usually on the caudal, sometimes on the abdominal portion of the vertebral column; anal short. Derm naked. Dorsal and pectoral spines scarcely developed.

But three genera of this family are known to occur within the limits of the area under consideration; they are *Nematogenys*, *Hatcheria* and *Pygidium*. Their relationship will be seen from the following key to all the genera of the family.

- a.* Dorsal entirely in front of the ventrals; vomer with teeth; head compressed; anterior nares almost labial. Gill-membrane broadly united with the isthmus. Eye almost entirely concealed under the skin. A single maxillary barbel; two pairs of mental barbels. Opercles unarmed. (*Cetopsinae*)
 - b.* Teeth all conical or incisor-like, those on the vomer in a single series. *Hemicetopsis* Bleeker.
 - bb.* Teeth on the premaxillary villiform, in a band, those on the vomer and on the mandible incisor-like, in a single series. *Cetopsis* Agassiz.
 - bbb.* Teeth on the premaxillary and on the mandible villiform, in bands, those on the vomer in a single series. *Pseudocetopsis* Bleeker.
 - bbbb.* Teeth all villiform, in bands. *Paracetopsis* Eigenmann & Bean.
- aa.* Dorsal above or behind the ventrals; no teeth on the vomer.
 - c.* Gill-openings broad, the gill-membranes almost free or forming a free membrane across the isthmus. (*Pygidiinae*)
 - d.* Anal short; eyes superior; mouth terminal; gill-membranes free or almost free from the isthmus.
 - e.* Ventrals present.
 - f.* A single maxillary barbel; opercles and preopercle unarmed.
 - g.* Nasal barbels present; dorsal placed over the ventrals; one pair of mental barbels. *Nematogenys* Girard.
 - gg.* Nasal barbels obsolete; dorsal placed behind the ventrals; two pairs of mental barbels. *Pariolius* Cope.
 - ff.* Two maxillary barbels; opercle and preopercle with osseous prickles; nasal barbels present.
 - h.* Caudal peduncle broad; caudal with numerous accessory rays. *Pygidium* Meyen.
 - hh.* Caudal peduncle slender; caudal with very few accessory rays; dorsal emarginate. *Hatcheria* Eigenmann.
 - ee.* Ventral fins none; otherwise like *Pygidium*. *Eremophilus* Humboldt.
 - dd.* Anal long, partly in front of the dorsal; head greatly depressed; eyes infringing on the upper and lower surfaces of the head; mouth inferior; gill-membranes broadly joined to each other, free from the isthmus; opercle and preopercle with osseous prickles; a series of fine labial teeth. *Tridens* Eigenmann & Eigenmann.
- cc.* Gill-membranes confluent with the skin of the isthmus, the gill-opening a narrow slit in front of the pectoral; opercle and preopercle armed with spines; vent far behind the middle of the body; anal short. (*Stegophilinae*)
 - i.* Upper lip with several series of numerous small, movable teeth; each jaw with several series of minute teeth; mouth inferior.
 - j.* Gill-membranes broadly united with the isthmus.

- k. Caudal widely forked, the upper lobe produced in a filament; a single maxillary barbel. *Pseudostegophilus* Eigenmann & Eigenmann.
- kk. Caudal emarginate.
 l. A single maxillary barbel. *Henonema* Eigenmann.
 ll. Two maxillary barbels. *Homodiætus* Eigenmann.
- kkk. Caudal rounded.
 m. A single maxillary barbel. *Stegophilus* Reinhardt.
 mm. Two maxillary barbels. *Miuroglanis* Eigenmann & Eigenmann.
- jj. "Rimæ branchiales confluentes, membrana branchiostega cum isthmo gulare haud connexa;" caudal rounded; maxillary barbel single; no accessory caudal rays. *Acanthopoma* Lütken.
- ii. No labial teeth; teeth in the jaws in a single series.
 n. Teeth pointed, in a single series in the intermaxillaries only; mouth sub-inferior; a single maxillary barbel. *Vandellia* Cuvier & Valenciennes.
 m. Teeth broad, incisor-like in both jaws; caudal forked; two maxillary barbels. *Pareiodon* Kner.

5. NEMATOGENYS Girard.

Nematogenys Girard, Proc. Acad. Nat. Sci. Phila., VII, 1854, 198 (*inermis*).

Type: *Trichomycterus inermis* Guichenot.

Dorsal fin placed over the ventrals, without a spine. Fontanel extending to base of occipital process, interrupted above the posterior margin of orbit. Opercle and preopercle unarmed. A single barbel on each maxillary and one pair of mental barbels.

Habitat: Central Chili.

9. NEMATOGENYS INERMIS (Guichenot).

(Plate XXXI, Fig. 2, and Plate XXXII, Fig. 2.)

Trichomycterus inermis Guichenot, in Gay Hist. Chile Zool., II, 312, pl. ix, fig. 2, 1848 (Chili).

Nematogenys inermis Girard, Proc. Acad. Nat. Sci. Phila., VII, 1854, 198; id. U. S. Naval & Astron. Exped. 240, pl. xxxii, 1855 (Rio de Maypu near Santiago); Philippi, MB. Ak. Berl., 716, 1866 (Chili); Günther, Cat., V, 272, 1864 (copied); E. & E. Proc. Cal. Acad. Sci., 2d Ser., II, 50, 1889 (Curico; Santiago); id. South Am. Nematognathi, 322, 1890 (Curico; Santiago).

Nematogenys nigricans Philippi, l. c., 716 (Chili).

Nematogenys pallidus Philippi, l. c., 716 (Chili).

Habitat: Fresh waters of Central Chili.

N. nigricans and *pallidus* seem to be color varieties of *N. inermis*.

Tail compressed, head depressed, the caudal peduncle about as deep as the body. Head entirely covered with soft skin, little longer than wide, its depth $1\frac{3}{5}$ –2 in its length. Eye small, superior; interocular width little less than length of snout; orbit without a free margin. Mouth wide, terminal, each jaw with a rather deep band of villiform teeth.

Gill-membranes narrowly joined to the isthmus.

Anterior nasal opening with a barbel which is about $1\frac{1}{2}$ times as long as the eye; a series of pores extending from it backward below the eye; a prominent pair of pores between the eyes.

Pectoral pore minute, above and behind the pectoral spine.

Origin of dorsal fin one-fifth nearer tip of snout than to base of middle caudal rays in specimens .12 meter long, one-fifth nearer base of caudal rays than to tip of snout in a specimen .26 meter long.

Margin of all the fins rounded. Caudal with numerous accessory rays, the middle caudal rays $1-1\frac{1}{3}$ in the head. Origin of ventrals below or slightly behind the first dorsal ray. Inner margin of pectoral spine serrate, its lower surface spiny.

Light brown mottled with darker, a series of about 5 light areas along the lateral line; fins speckled.

Head $4\frac{1}{3}$ – $3\frac{4}{5}$; depth 7–6; D. 10; A. 11; Br. 10–12.

This species does not belong to the tropical American fauna. Nor can it technically be referred to the Patagonian fauna, since no specimens have been recorded south of Central Chili. It occupies intermediate ground and possibly touches the Patagonian region on its northwestern frontier.

This account is based on material in the Museum of Comparative Zoölogy.¹

¹ PYGIDIUM Meyen.

Trichomycterus Valenciennes, Humboldt, Rec. d'Obs. Zool. et Anat. II, 348, 1833 (*nigricans*) not

Thrichomycterus Humboldt.

Thrychomycterus Cuv. & Val. XVIII, 485, 1846 (misquoted).

Thrichomycterus Girard, Proc. Acad. Nat. Sci. Phila., VII, 1854, 198; Girard, U. S. Nav Astron. Exped. II, 242, 1855 (misquoted).

Pygidium Meyen, Reise, I, 475, 1835 (*fuscum*).

Type: *Pygidium fuscum* Meyen.

Habitat: Andes from Central Chili to Colombia; Callao Bay; Amazon to Cudajas; South-eastern Brazil; Central Argentine Republic.

The reasons for using the name *Pygidium* instead of the older *Trichomycterus* were given by Eigenmann & Eigenmann, S. A. Nematognathi, 325. Inasmuch as some naturalists still persist in using the name *Trichomycterus*, the statement made by us may be repeated:

6. HATCHERIA Eigenmann gen. nov.

Type: Hatcheria patagoniensis sp. nov.

Dorsal long, emarginate; caudal with very few accessory rays, which are graduated; anal below the posterior half of the dorsal; caudal peduncle very slender; caudal emarginate, the lobes rounded.

SPECIES OF HATCHERIA.

- a.* D. 21; origin of dorsal equidistant from occiput and tip of caudal; anal inserted below the ninth dorsal ray and terminating under the seventeenth; ventrals extending to vent. 10. *macræi*.
aa. D. 15; origin of dorsal equidistant from tip of snout and tip of caudal; last ray of anal under last ray of dorsal; distance of anal from base of caudal $3\frac{3}{4}$ in the length. 11. *maculata*.
aaa. D. 15; origin of dorsal equidistant from tip of caudal and posterior nares; gill openings not extending forward to eye; last anal ray under last dorsal ray; distance of anal from base of caudal about $4\frac{1}{2}$ in the length. 12. *patagoniensis*.
aaaa. D. 14; origin of dorsal equidistant from tip of caudal and occiput, its last ray over fourth ray of anal; gill openings extending forward to below eye, the membrane free from the isthmus; distance of anal from base of caudal 5 in the length. 13. *areolata*.

10. HATCHERIA MACRÆI (Girard).

(Plate XXXII, Figs 1, 1a and 1b.)

Thrichomycterus macræi Girard, U. S. Naval and Astronomical Expedition 245, 1855 (Uspullata, elevation, 7000 feet).

The only claim for retention the name *Thrichomycterus* possesses is its distinctiveness from *Thrichomycterus* Humb. = *Eremophilus* Humboldt. Twenty-two years before any species of *Thrichomycterus* Val. was known, the name *Thrichomycterus* was proposed by Humboldt as an alternative for his *Eremophilus*, if future investigations should prove *Eremophilus* to be objectionable. Upon proposing the name *Thrichomycterus* Valenciennes states: "Nous prenons pour le nouveau genre le nom de *Thrichomycterus* imaginé par M. de Humboldt," so the names can hardly be considered distinct, being either a misprint or a lapsus digiti. Valenciennes afterwards misquotes himself, spelling the name *Thrychomycterus* instead of *Thrichomycterus*. Girard also misquotes Valenciennes or quotes Humboldt correctly, using *Thrichomycterus* instead of *Thrichomycterus*.

This genus has a wide distribution, extending along the Andes from Caracas to Chili on both slopes. It is distinctly a mountain form, but it descends the Pacific slope to the coast at Callao and the Amazon to Cudajas. It further occurs in the highlands of Guiana and Eastern Brazil. There are in all about 35 species known. Some of these are found on both sides of the Andes, but none have a wide distribution. On the contrary, the species seem to be local differentiations of this widely distributed genus. Contrary to the general rule of distribution of South American fresh-water fishes, that a genus with many species and a wide distribution has many representatives in certain favorable localities, there is no place on record harboring more than one species of this genus. We may expect the finding of many other species as restricted basins or isolated valleys of the Andes and the temperate portions of South America are explored.

The genus is without doubt one of very long standing. In Central Chili and Patagonia it has become differentiated into *Hatcheria*.

Pygidium macraei Eigenmann & Eigenmann, Proc. Cal. Acad. Sci. 2d ser., II, 51, 1889 (Uspullatuo); id., South Am. Nematognathi 328, 1890 (Uspullatuo).

Elongate, rather compressed, especially backward. Head as broad as long, snout rounded; eye small, midway between tip of snout and end of opercle; none of the barbels reaching the gill-opening.

Gill-opening scarcely continued forward, joined to the isthmus for a distance equal to half the width of the mouth.

Pectorals obliquely truncate, the first ray not produced; origin of dorsal some distance behind ventrals, equidistant from occiput and tip of caudal; fourth or fifth dorsal ray highest, then gradually decreasing in height to the last. Caudal emarginate, the upper lobe pointed, the lower rounded; anal inserted below the 9th dorsal ray and terminating under the 17th; ventrals inserted nearer tip of snout than to tips of middle caudal rays, reaching to the vent. Head $6\frac{1}{2}$ (7 in the total); depth 6; D. 21. A. 10.

This account is drawn from a specimen (No. 8298) in the Museum of Comparative Zoölogy. It came from Uspullatuo and is probably the type of the species.

11. HATCHERIA MACULATA (Cuvier & Valenciennes).

(Plate XXXIII, Figs. 1, 1a and 1b.)

Trichomycterus maculatus Cuvier & Valenciennes, Hist. Nat. Poiss., XVIII, 493, 1846 (Santiago); Guichenot in Gay, Hist. Chile Zool., II, 311, 1848 (Chili); Günther, Cat. Fish. Brit. Mus. V, 273, 1864; Girard, Proc. Acad. Nat. Sci. Phila., VII, 1854, 199 (Mapocho); Philippi, Mb. Akad. Wiss. Berl. 1866, 716; Delfin, Catalogo de los Pesces de Chile, 30, 1901.

Thrichomycterus maculatus Girard, in part, U. S. Naval and Astronomical Expedition 243, 1855 (Rio Mapocho).

Pygidium maculatum Eigenmann & Eigenmann, Proc. Cal. Acad. Sci. 2d ser., II, 51, 1889 (Rio Mapocho); id., South Am. Nematognathi 329, 1890 (Rio Mapocho).

Elongate, somewhat compressed; head as long as wide; caudal peduncle long and slender. Eye small, midway between tip of snout and end of opercle. Lips and lower surfaces of the head thickly covered with

warts. Gill-openings not continued forward to below the eye, the membranes joined to the isthmus for a distance equal to one-third the width of the mouth.

Pectorals rounded, the first ray not produced; origin of dorsal in front of the vent, but some distance behind the ventrals, equidistant from tip of snout and tip of caudal, its last ray over the last ray of the anal. Caudal long, truncate. Anal short and high, its height about equal to the length of the caudal, its distance from the base of the caudal $3\frac{3}{4}$ in the length. Origin of the ventrals equidistant from tip of snout and base of caudal, their tips reaching beyond the vent.

Back and sides marbled with light and dark brown; fins pale, immaculate.

Head $5\frac{1}{3}$ ($6\frac{1}{4}$ in the total); depth $7\frac{1}{2}$; D. 15; A. 9. This account is based on a specimen in the Museum of Comparative Zoölogy.

12. *HATCHERIA PATAGONIENSIS* Eigenmann sp. nov.

(Plate XXXIII, Fig. 2; and Plate XXXIV, Figs. 1 and 1a.)

Type: A specimen 118 mm. long. Rio Blanco, base of Andes. Lat. $47^{\circ} 30'$ S.; long. 72° W. Hatcher, collector.

Cotypes, 8 specimens, 96–113 mm.

Elongate, slender; head, 5; depth 8; caudal peduncle slender, its depth nearly 3, in the head, about 4 in its length; upper maxillary barbel reaching pectoral, lower to margin of interopercle, a broad lobe of skin joining base of lower maxillary barbel to the lower lip; snout pointed, mouth narrow, its width $3\frac{1}{2}$ in head, equal to interorbital; nasal barbels reaching beyond eye; width of head but little less than its length; greatest width of body behind the pectorals, 1.6 in the length of the head. Gill opening not extending forward to below eye; origin of dorsal equidistant from tip of caudal and posterior nares; base of dorsal equal to its distance from the caudal, its free surface emarginate, the anterior lobe rounded, the posterior pointed; beginning of last third of dorsal not much more than half as high as anterior lobe. Caudal moderate, emarginate, its lobes rounded, .8 of the length of the head. Anal broadly rounded, its last ray about under last ray of dorsal. Ventrals broad, their middle under origin of dorsal, $1\frac{1}{2}$ in head, equal to height of anal. Base of pectoral horizontal, closing edgewise to body, its lower part folded when appressed;

first ray sickle-shaped, slightly prolonged. Dark yellowish, more or less regularly spotted with darker, dorsal and caudal and pectorals irregularly blotched with black. D. (13) 15; A. 6.

Some of the cotypes are more robust in body; in one the anal is blotched like the caudal; in some the spots form regular series along the sides leaving lighter stripes between them.

13. *HATCHERIA AREOLATA* (Cuvier & Valenciennes).

(Plate XXXIV, Fig. 2.)

Trichomycterus areolatus Cuvier & Valenciennes, Hist. Nat. Poiss., XVIII, 492, 1846 (Coast of Chili); Guichenot, in Gay Hist. Chile, Zool., II, 309, 1848; Günther, Cat. Fish. Brit. Mus., V, 274; Delfin, Catalogo de los Peces de Chile, 30, 1901; Philippi, Mb. Akad. Wiss. Berlin, 1866, 714.

Pygidium areolatum Eigenmann & Eigenmann, Proc. Cal. Acad. Sci., 2d ser., II, 51, 1889 (Rio Mapocho); id. South American Nematognathi, 330, 1890 (Mapocho); Berg, An. Mus. Nac. Buenos Aires, IV, 143, 1895 (Coidola); Evermann & Kendall, Proc. U. S. Nat. Mus. XXXI, 86, 1906 (Rio Comajo; tributary of Lake Traful; tributary of Rio Limay).

Trichomycterus maculatus Girard, in part, U. S. Naval and Astronomical Expedition 243, 1855 (Mapocho).

Elongate, subterete. Lips and lower surfaces of head thickly covered with small warts. Gill-openings continued forward to below the eye, the membranes free from the isthmus. Upper maxillary barbels reaching to the pectorals. Pectorals rounded, the first ray not prolonged; origin of dorsal slightly in front of the vent, equidistant from tip of caudal and occiput, its last ray over the fourth ray of the anal. Caudal very slightly emarginate. Distance of anal from the base of the caudal 5 in the length. Origin of the ventrals equidistant between tip of snout and middle of caudal; tips of the ventrals not reaching the vent.

Light brown, with purple longitudinal streaks.

Head $5\frac{3}{4}$ ($6\frac{2}{5}$ in the total); depth $8\frac{1}{2}$; D. 14; A. 8.

Based on a specimen in the Museum of Comparative Zoölogy.

Order III. PLECTOSPONDYLI.

Cope, Am. Assoc. Adv. Science, Indianapolis, 1871, 332.

As stated ante, p. 238, this order falls naturally into three groups of families which are considered suborders and distinguished as follows:

- a.* Lower pharyngeals falciform, parallel with the gill arches, usually provided with teeth; mouth more or less protracted, usually bordered by the premaxillaries only; jaws toothless; brain case produced between the orbits; basis cranii simple; no adipose. *Eventognathi.*
- aa.* Lower pharyngeals normal; mouth not protracted; teeth in the jaws or none; brain case usually not produced between the orbits; basis cranii double.
 - b.* Not eel-shaped; vent submedian; a dorsal fin and usually an adipose dorsal; ventrals abdominal; mouth usually bordered by the premaxillary and maxillary, more rarely by the premaxillary only. *Heterognathi.*
 - bb.* Eel-shaped; vent under the head or at throat; dorsal obsolete; ventrals wanting. *Gymnonoti.*

Of these suborders the *Eventognathi* belong to the northern hemisphere, not a single species having reached South America through natural channels.

The *Gymnonoti* are exclusively South American, reaching from Guatemala to La Plata. No species approach the Patagonian region.

Suborder HETEROGNATHI.

The *Heterognathi* are composed of one, possibly two families, the *Erythrinidæ*, peculiar to South America and the *Characidæ*, in South America and tropical Africa. The *Erythrinidæ* are not known to extend south of Buenos Aires.

Family IV. CHARACIDÆ.

Characini, Müller, Archiv Naturgesch., 9, Jahrg., I, 323, 1843.

Characinidæ, Richardson, Encycl. Brit., 8th ed., XII, 245, 1856.

Characinidæ, Günther, Cat. Fish, Brit. Mus. V, 278, 1864.

Characidæ, Gill, Mem. Nat. Acad. Sci. VI, 131, 1893.

The *Characidæ* flourish in the tropical fresh-waters; but one species reaches as far north as the boundary of the United States. Of the *Characidæ* inhabiting the fresh-waters of tropical America, numbering about 100 genera and nearly 500 species, only two reach with certainty the region under consideration. Both of these belong to the *Tetragonopterinæ*.

A third one is recorded from south of Buenos Aires without a distinct locality.¹ It is without scales and forms a distinct subfamily closely allied to the *Tetragonopterinae*.

The relation of the Patagonian forms to those of other regions is shown by the following keys to the subfamilies of *Characidae* and to the genera of *Tetragonopterinae*.

SUBFAMILIES OF CHARACIDÆ.²

- a.* Teeth none ; an adipose fin.
 - b.* Gill-rakers none ; intestine very long. I. *Curimatinae*, American.
 - bb.* Gill-rakers long, clupeiform ; fourth gill arch with raker-like organs behind. II. *Anodinae*, American.
- aa.* Teeth minute, mostly depressible ; nares close together ; gape short, mouth usually small ; an adipose fin.
- c.* Last gill-arch normal.
 - d.* Jaws well developed, the mandibles firm ; teeth more or less spatulate, more or less firmly joined to the jaws ; dorsal variable.
 - e.* Scales cycloid ; teeth serrate or spoon-shaped ; gill-membranes free from isthmus and from each other ; no predorsal spine. III. *Hemiodontinae*, American.
 - ee.* Scales ctenoid.
 - f.* Gill-membranes free from the isthmus. IV. *Neolebiinae*, African.
 - ff.* Gill-membranes joined to the isthmus. V. *Distichodontinae*, African.
 - dd.* Jaws very weak, mandibles transverse ; teeth on the margins of fleshy lips, freely movable, spatulate ; mouth subterminal, broad ; dorsal short ; gill-membranes joined to isthmus ; a movable, procumbent, predorsal spine. VI. *Prochilodinae*, American.
- cc.* Last gill-arch modified.

¹ GYMNOCHARACINUS Steindachner.

(Plate XXXIV, Figs. 3 and 3a.)

Gymnocharacinus Steindachner, SB. Akad. Wiss. Wien, CXII, 20, 1903 (type *bergii*).

This genus differs from all other *Characins* in being naked.

GYMNOCHARACINUS BERGII Steindachner.

Gymnocharacinus bergii Steindachner, SB. Akad. Wiss. Wien, CXII, 20, 1903. (A brook from southern Argentina, exact locality not given.)

Head 4 ; depth $3\frac{2}{3}$; D. 11 ; A. 13 ; V. 6-7. Snout blunt, jaws equal ; maxillary not reaching to middle of eye ; width of head 1.5 in its length ; eye 4 in head ; interorbital nearly 3 ; base of dorsal 2.4 in the head, its height 1.75 ; ventrals 2.4 ; base of anal less than twice in head ; brown, a dark brown lateral band from the head to the caudal.

² The African genera are interpolated here although they very probably underwent a separate evolution and their position in the key does not represent their relationship.

- g.* Dorsal short; lower jaw composed of three elements; teeth minute, in a single series; gill-membranes grown to the isthmus; lower jaw with a longitudinal extent; premaxillary rudimentary. VII. *Chilodinae*, American.
- gg.* Dorsal elongate, with 17-23 rays; fourth gill arch with an accessory respiratory organ; lower jaw composed of two elements; teeth minute, ciliform, in a single series in each jaw; anterior air bladder partly enclosed in a bony capsule. VIII. *Citharininae*, African.
- aaa.* Teeth well developed, fixed in the jaws; an adipose fin or none.
- h.* Maxillary not rudimentary, not ankylosed with the premaxillary; premaxillaries not coössified; teeth compressed, truncate, notched, denticulate or serrate; sometimes canines also present. (See also *Bramocharax*.) Alimentary canal short.
- i.* Belly rounded before the ventrals; teeth truncate, notched or serrate.
- j.* No scales; no adipose; teeth in premaxillary in two rows, in maxillary and mandible in single series, narrow at base, broad at tip, 3-5 pointed; a long fontanel in occiput. IX. *Gymnocharacininae*, south of Buenos Aires.
- jj.* Body fully scaled.
- k.* Skull with a parietal, and usually in the American genera, with a frontal fontanel; teeth in the lower jaw not in two complete series.
- l.* Premaxillary and mandible with a single series of teeth.
- m.* Dorsal with 11 rays or fewer.
- n.* Large frontal and parietal fontanels. Gill-membranes united, usually joined to the isthmus, free from it in some genera; intestine short; mouth small with little or no lateral extent; nares close together or remote. X. *Anostomatinae*, American.
- nn.* No frontal fontanel, parietal fontanel if present confined to the occipital region. Gill-membranes sometimes slightly united, usually free from each other and from the isthmus; nares remote; mouth minute; adipose present or absent; no teeth on maxillary. XI. *Nannostomatinae*, American.
- nnn.* Gill-membranes free from the isthmus and from each other; nares close together, separated by a flap only; fontanels large, separating the parietals and the frontals to at least the middle of the eye; adipose always present; maxillary with teeth. XII. *Aphiocharacinae*, American.
- nnm.* Dorsal with 15 rays. XIII. *Crenuchinae*, American.
- ll.* Premaxillary with two or more series of teeth; nares approximate.
- o.* Gill-membranes united, free from isthmus; a single series of teeth in the lower jaw. XIV. *Iguanodectinae*, American.
- oo.* Gill-membranes free from each other and from the isthmus.
- p.* Opercle prolonged; premaxillary with two, mandible with a single series of teeth; belly not keeled; gill-membranes free from isthmus; rakers close together.
- q.* Adipose fin present; no rakers on lower limb of anterior gill-arch; anal long (31); dorsal in part in front of anal. XV. *Diapominae*, Rio Grande do Sul.

- qq.* No adipose; dorsal over anal, higher than long; anal long (20-31). XVI. *Stevardiinae*, Trinidad.
pp. Opercle not prolonged; usually a single series of teeth in the lower jaw, some genera imperfectly with two series.
 XVII. *Tetragonopterinae*, American and African.
kk. Skull without fontanels; mandible with two series of teeth.
r. An adipose dorsal; walls of the air-bladder not cellular.
 XVIII. *Piabuciniæ*, American.
rr. No adipose fin; walls of the anterior portion of the posterior air bladder cellular; premaxillary, maxillary, and outer series of the teeth of the dentary tricuspid.
 XIX. *Lebiasiniæ*, Pacific slope of Peru to Colombia.
ii. Belly compressed before the ventrals; no ventral spines; intestine short; gill-rakers moderate; nares close together.
s. Pectorals large, nearly or quite reaching anal, placed high or moderately so; gill-membranes free; breast more or less expanded.
 XX. *Gasteropeliciæ*, American.
ss. Pectoral small, placed low.
t. Body elongate; anal basis nearly horizontal.
 XXI. *Agoniatinae*, American.
tt. Body deep; anal basis very oblique; mouth very oblique; pectorals on a level with or below the level of the lower margin of the preopercle.
 XXII. *Stethaprioninae*, American.
iii. Belly trenchant and serrate, at least behind the ventrals; intestine short; body compressed and deep.
u. All teeth in the jaws in a single series, trenchant or serrate; gill-rakers mostly short.
 XXIII. *Serrasalmoninae*, American.
uu. Premaxillary teeth in two series, teeth tricuspid or truncate; gill-rakers various.
 XXIV. *Myliæ*, American.
hh. The minute maxillary ankylosed with the premaxillary.
v. Premaxillaries coössified; dentaries coössified; teeth conical or compressed, uni-, bi-, or tricuspid; lateral line along middle of body; alimentary canal short; nares close together; scales ctenoid.
vv. Fontanel minute or absent; maxillary bordering the mouth.
 XXV. *Phaginae*, African.
ww. A large fontanel separating the parietals and frontals to the eyes; maxillary not bordering the mouth; snout prolonged. XXVI. *Ichthyoborinae*, African.
vv. Premaxillaries not coössified; maxillary in part bordering mouth, its posterior, toothless portion meeting the toothed part at an angle, snout not much prolonged; a few large triangular teeth in each jaw, nares close together; lateral line below the middle of body; fontanel separating the parietals and sometimes in part the frontals.
 XXVII. *Hydrocyoninae*, African.
hhh. Premaxillaries not coössified; maxillary not rudimentary, not ankylosed with the premaxillary; the teeth conical or compressed (see *Bramocharax*); nares close together; gill-membranes free from isthmus; alimentary canal short.
x. Fontanel present.

- y.* Belly compressed ; body long and narrow, knife-like anal long ; teeth unequal ; a pair of large canines in the lower jaw in front, received in two grooves in the palate ; palate with minute teeth ; gill-rakers reduced to slight denticles.
XXVIII. *Cynodontinae*, American.
- yy.* Belly rounded or the body not long and narrow.
- z.* No teeth on the palate ; snout comparatively short ; teeth all moderate in size, sometimes strong canines ; gill-rakers strong ; nares approximate ; gill-membranes free from isthmus. XXIX. *Characinae*, American.
- zz.* Teeth on the palatines.
- A.* Snout very elongate ; palatine teeth minute, granular ; anal short ; intestine short. XXX. *Hydrocyninae*, American.
- AA.* Snout moderate ; some of the teeth canines ; palatine teeth conical, in a single series ; anal long ; intestine short.
XXXI. *Acestrorhamphinae*, American.
- x.* No fontanel.
- B.* An adipose fin. Premaxillary with a backward projecting process between the maxillary and the palatines, the process provided with small teeth ; no occipital crest ; skull as in *Erythriniæ*. Snout much prolonged.
XXXII. *Sarcodacinae*, African.
- BB.* No adipose dorsal ; skull above more or less truncate behind, the supraoccipital confined to the posterior surface and carinated by a rudimentary or obsolete vertical crest ; adipose fin none ; gill-opening wide, the membranes slightly united, free from the isthmus. Dorsal in advance of the anal, usually over or a little behind the ventrals ; A. 10-13.
- c.* Gape very wide, premaxillary and dentaries with strong canines ; lateral line developed ; caudal rounded. XXXIII. *Erythriniæ*.
- cc.* Gape oblique ; maxillary with a few slender teeth, no canines ; lateral line obsolete or developed anteriorly only ; caudal forked or emarginate. Walls of the air bladder normal ; teeth all conical.
XXXIV. *Pyrrhuliniæ*, American.

GENERA OF TETRAGONOPTERINÆ.

- a.* Jaws equal, the lower not included ; mandibular teeth meeting the second of the premaxillary series. Premaxillary with two series of teeth.
- b.* Mandibles without conical teeth in front.
- c.* Gill-rakers short, lanceolate ; anal long (29) ; lateral line complete ; maxillary with conical teeth along half of its length ; premaxillary and mandibular teeth as in *Tetragonopterus*. *Scissor* Günther.
- cc.* Gill-rakers setiform.
- d.* Maxillary short, the snout and maxillary together less than half length of head. Teeth of the lower jaw all alike in character and regularly graduated from in front to the last tooth on the sides ; two teeth in the front row of the premaxillary on each side ; teeth of the second row multicuspid incisors with contracted base, their anterior and posterior surfaces alike, convex, without distinct ridges. Lateral line complete. *Deuterodon* Eigenmann.

- ad.* Snout and maxillary forming at least half the length of the head ; lateral line incomplete.
- e.* Maxillary with 0-4 teeth ; jaws equal ; premaxillary teeth five-pointed, in an outer row of about 8 teeth and an inner row of about 10 teeth ; maxillary usually with 2 teeth ; anterior mandibular teeth stronger than those of the premaxillary, 10-12 in number ; sides of the lower jaw with a long row of very small single-pointed teeth.
Cretochanes Günther.
- ee.* Maxillary with teeth along its entire edge ; lateral line very short. Species with dark lines along the sides.
- f.* Anterior teeth of lower jaw all alike, tricuspid ; anterior pair of premaxillary teeth little larger than the rest. *Hollandichthys* Eigenmann.
- ff.* Lateral teeth of lower jaw enlarged, canine-like, the fourth usually largest ; middle teeth of premaxillary much enlarged.
Pseudochalcus Kner.
- bb.* Mandibles with a pair of conical teeth behind the front series. Teeth otherwise all alike imbricate, compressed, five-pointed ; dorsal placed behind ventrals ; scales large. Toothed portion of maxillary-premaxillary border horizontal. *Henochilus* Garman.
- aa.* Lower jaw included. Teeth of the front of the lower jaw strong, graduated, with ridges on the anterior surface, those of the sides abruptly smaller (except in *Hemibrycon*) and inconspicuous ; upper jaw short, the lower jaw oblique when closed, its teeth pointing backward and upward when the jaw is closed, frequently enclosed in the inner series of the upper jaw.
- g.* Premaxillary teeth in two series. (See also *Bryconops*.)
- h.* Lower jaw without a pair of conical teeth.
- i.* Maxillary with teeth along its entire length or nearly its entire length.
- j.* Lateral line interrupted. *Holopristis* Eigenmann.
- jj.* Lateral line complete. *Hemibrycon* Günther.
- ii.* Maxillary with 0-5 teeth at its anterior upper end.
- k.* Depth more than half the length ; no predorsal spine ; preventral region flat. *Tetragonopterus* Cuvier.
- kk.* Depth less than half the length.
- l.* Anal and caudal naked.
- m.* Lateral line interrupted. *Hemigrammus* Gill.
- mm.* Lateral line complete.
- n.* American. Maxillary frequently with teeth. More than 3 scales between ventral and l.l. *Astyanax* Baird & Girard.
- nn.* African. Maxillary without teeth. *Petersius* Hilgendorf.
- ll.* Anal or caudal scaled.
- o.* Anal naked ; caudal scaled.
- p.* First and second series of premaxillary teeth in approximately parallel series. *Monkhausia* Eigenmann.
- pp.* First series of premaxillary teeth in a wavy line or imperfectly in two series. *Bryconamericus* Eigenmann.
- oo.* Anal and caudal scaled ; anal long, convex. Postventral region compressed, the scales not passing over it.
Markiana Eigenmann.

- hh.* Mandible with a pair of conical teeth behind the middle of the front series.
- q.* Both series of teeth of upper jaw simply compressed; dorsal beginning above or behind ventrals.
- r.* Lateral line complete. *Micralestes* Boulenger (African).
- rr.* Lateral line incomplete. *Phenacogrammus* Eigenmann (African).
- qq.* Inner series of teeth of the upper jaw tuberculate; no maxillary teeth; a series of large, compressed multicuspid teeth in the lower jaw, similar to those in *Astyanax*.
- s.* A parietal, no frontal fontanel. *Brycinus* Cuv. & Val. (African).
- ss.* A parietal and a frontal fontanel.
- t.* Origin of dorsal over or behind ventrals. *Myletes* Cuvier (African).
- tt.* Origin of dorsal in front of ventrals; premaxillary teeth imperfectly in three series. *Bryconæthiops* Günther (African).
- gg.* Premaxillary teeth in three or more series.
- u.* Lower lip very broad, pendant. *Othonophanes* Eigenmann.
- uu.* Lower lip normal.
- v.* Mandible frequently with a pair of conical teeth behind the middle of the front series except sometimes in *Megalobrycon*.
- w.* Scales moderate, 35 in the lateral line; anal with 20–23 rays. *Bryconæthiops* Günther (African).
- ww.* Scales moderate or small, more than 45 in the lateral line; anal rays more than 20.
- x.* Lower jaw with a second series of teeth, at least on the sides. *Brycon* Müller & Troschel.
- y.* Anal rays more than 30. (*Chalcinopsis* Kner).
- yy.* Anal rays fewer than 30; belly not keeled.
- z.* Lower jaw sometimes without conical teeth (*Megalobrycon* Günther.)
- zz.* Lower jaw with a pair of conical teeth. (*Brycon*.)
- vv.* Lower jaw without a pair of conical teeth in front, and without an inner series of conical teeth on the sides.
- A.* Ventrals below anterior dorsal rays; anal with 32–38 rays; maxillary without teeth; premaxillary with two or three, mandible with a single series of teeth. *Bryconops* Kner.
- AA.* Ventrals in front of dorsal or just under anterior rays. Anal short, of 12–22 rays; maxillary with a few blunt teeth; three series of notched teeth in the premaxillary, a single series in the lower jaw. *Creagrutus* Günther.

7. CHEIRODON Girard.

Cheirodon Girard, Proc. Acad. Nat. Sci. Phila., VII, 1854, 199 (*pisciculus*).

Type: *Cheirodon pisciculus* Girard.

Premaxillary, mandible and sometimes the anterior part of the maxillary each with a single series of multicuspid incisors; dorsal short; opercle

not prolonged; belly rounded; gill membranes free from each other and from the isthmus.

This genus is found in the Rio Magdalena, Rio San Francisco, in the Amazon and south to the La Plata basin and from Santiago to Puerto Montt on the Pacific slope. The relationship of *pisciculus*, which enters the Patagonian area, to the other species of the genus can be expressed by the following key to the species.

a. Maxillary with a single tooth or none.

b. A black caudal spot; a bright longitudinal band on the sides; maxillary without teeth in the majority of individuals; A. 20-27, usually 21-25; scales 5 or 6-30 to 36-5 or 6, infrequently 7 scales above the lateral line; depth $2\frac{2}{5}$ to $2\frac{4}{5}$; head $3\frac{3}{5}$ to $4\frac{1}{5}$; eye $3\frac{2}{5}$ to 4. *interruptus* Jenyns.

bb. No caudal spot, or the spot very obscure; maxillary with a single tooth or none.

c. Anal 19-22; depth 2.6; head 3.6; eye 3 in head; scales 3-32-4; D. 10; an indistinct dark caudal spot; a bright silvery longitudinal band. *monodon*¹ Cope.

cc. Anal 12-15; depth 3-4; head 3-4; eye 3 in head; scales 6-33 to 36-5; D. 10-12; a silvery lateral band, no black markings. *annæ* McAtee.

aa. Maxillary with more than one tooth.

d. Anal short, of but 14 rays; D. 10; teeth usually five-pointed; a silvery lateral band margined above with black; depth 3-4 in the total length; head 5; eye 3 in head.

14. *pisciculus* Girard.

dd. Anal with 19-26 rays.

e. A black spot at base of caudal; scales 30-32.

f. Anal 23-26; no humeral spot, an intense dark violet spot on the base of caudal and continued to the tip of middle rays; a light yellow spot just behind the dark caudal spot on the upper and lower caudal rays; a conspicuous violet stripe from behind the ventrals along the entire base of the anal, a branch extending from the base of the first three or four anal rays obliquely to the tip of the 6th and 7th rays and back along the remaining rays; head $3\frac{1}{3}$ - $3\frac{1}{2}$; depth $3\frac{1}{2}$ - $3\frac{2}{3}$; D. 9-10; lat. line 30; mouth very oblique, lower jaw projecting; teeth numerous, very small and slender; interorbital bones entirely covering the lower cheeks. *nattereri* Steindachner.

ff. Anal 21-24; no humeral spot, sometimes a rounded spot on each side of the belly between the ventrals and anal; caudal spot continued on the middle rays but not reaching the end; sometimes a black line extending forward; head $3\frac{1}{2}$ - $3\frac{2}{3}$; depth $2\frac{2}{3}$ -3; eye nearly twice as long as the snout, 2.5-2.66 in the head; maxillary without teeth; D. 9; scales 32-34.

calliurus Boulenger.

¹The dorsal profile of one of Cope's types, kindly sent for examination by the Philadelphia Academy, is more strongly arched than the ventral and the caudal spot appears under the lens as a scattered series of contracted pigment cells. In specimens at hand of *interruptus* the ventral profile is more strongly arched than the dorsal, and the caudal spot is large and conspicuous; otherwise the species are very similar.

- fff.* Anal 19; humeral spot when present not conspicuous; caudal spot not continued to the tips of the middle rays; in some specimens the lower accessory rays of the caudal spine-like; D. 11; lat. line 30-31; head $3\frac{2}{5}$ - $3\frac{1}{2}$; depth $2\frac{4}{5}$ -3; eye little more than 2 in the head. *insignis* Steindachner.
- cc.* No black caudal spot; scales about 35 in a longitudinal series, 9-10 in the lateral line; intermaxillary teeth 5, mandibular 7, maxillary 2-3; depth 3 in the length; D. 11; A. (2-20) 23; eye 3 in the head. *piaba* Lütken.

14. CHEIRODON PISCICULUS Girard.

- Cheirodon pisciculus* Girard, Proc. Acad. Nat. Sci. Phila. VII, 1854, 199; Girard, U. S. Naval and Astronomical Expedition, 249, pl. xxxiv, figs. 4-7, 1855 (Lagoons near Santiago, Chili); Eigenmann & Eigenmann, Proc. U. S. Nat. Mus., 1891.
- Chirodon pisciculus* Günther, Cat. Fish. Brit. Mus. V, 332, 1864 (copied); Steindachner, Zool. Jahrb. Suppl. IV, 328, 1898 (source of Rio Maulin, Lake Llanguihue at Puerto Montt).

This species is known only from the types and from a specimen from Puerto Montt.

8. ASTYANAX Baird & Girard.

- Astyanax* Baird & Girard, Proc. Phila. Acad. Sci. VII, 1854; Girard, U. S. Mex. Bound. Survey, 74, 1859 (*argentatus*).
- Pæcilurichthys* Gill, Ann. N. Y. Lyc. Nat. Hist., 54, 1858 (*brevoortii*).
- Type:* *Astyanax argentatus* Baird & Girard.

Premaxillaries with two series of teeth, the first series with several teeth on each side; mandible with strong teeth in front and very small ones on the sides, without conical teeth in front; teeth of premaxillary equal or graduated, their crowns ridged and denticulate. Gill-rakers setiform. No predorsal spine. Maxillary with 0-10 teeth. Lateral line complete. Form slender; depth mostly more than 2 in the length.

This is one of the largest genera of Characins. Its representatives are found from the borders of the United States to the Rio Negro on the east and Peru on the west, and from Para to the Cordilleras. Some of its species have a restricted range, while others (*A. rutilus*) have a range nearly coextensive with that of the genus. *Astyanax* (forms like *rutilus*, *abramis* and *bimaculatus*) is probably one of the oldest inhabitants of South America. Its allomorphism and wide distribution would indicate its long establishment. Very near relatives of this genus are found in Africa.

The only species known to enter the Patagonian region is *Astyanax rutilus* (Jenyns).

Günther recorded this species under the name of *Tetragonopterus petenensis* from the Rio Negro. The only recorded locality of *petenensis* is Lake Peten in Yucatan. Mr. C. Tate Regan has reëxamined the Rio Negro specimens and writes me: "I have no hesitation in referring the Rio Negro specimens to *Tetragonopterus rutilus*."

Rutilus is found from Panama (possibly Mexico) to Patagonia.

The relation of this species to the other members of the genus is shown by the following key :

- a. Anal rays 30 to 49.
 - b. Lateral line 55. Anal 45; head 3.6; depth 2.63; lat. line 55. Eye greater than snout by one-third of its diameter, greater than interorbital by $\frac{1}{6}$ – $\frac{1}{6}$ of its diameter.
 - 1. *erythropterus* (Holmberg).
 - bb. Lateral line with 50 scales or fewer.
 - c. Anal 40–48.
 - d. Scales 42–50.
 - e. Anal 47–48.
 - f. A few rudimentary teeth on the maxillary; a silvery lateral band; ventral profile much arched; snout pointed; A. 48. Lat. line 47.
 - 2. *spilurus* Cuv. & Val.
 - ff. No teeth on the maxillary; a very distinct silvery lateral band; an indistinct caudal and humeral spot; maxillary reaching anterior margin of orbit; depth 2.3; eye 3 in the head; scales 9 or 10–47–10 or 11; A. 47.
 - 3. *hauxwellianus* (Cope).
 - ee. Anal 41–45.
 - g. Scales 10–45 to 50–8 or 9; a small silvery lateral band; a dark spot on shoulder and another¹ on base of caudal; depth $2\frac{1}{8}$ – $2\frac{2}{3}$; A. 41–45; maxillary with a single, rather large caducous tooth; eye 2.4 in the head, about equal to interorbital. Head 4.1–4.5.
 - 4. *pelegrii* Eigenmann.
 - gg. Scales 8–42–7 or 8; A. 42; eye 3.7 in the head, 1.7 in the interorbital; head 3.7 in the length; a caudal spot.
 - 5. *correntinus* (Holmberg).
 - dd. Scales 37 or 38.
 - h. Several small teeth on the maxillary; head $3\frac{2}{5}$; depth 3 or somewhat more than 3; snout 4 in the head; a silvery lateral band bordered above by blue-green; a round humeral spot; caudal spot, when present, extends to the end of some of the caudal rays. A. 43; scales 6–37 or 38–4.
 - 6. *bairdii* (Steindachner).
 - hh. Maxillary with a single, small tooth. Scales in lateral line 37 or 38; both a caudal and a humeral spot very distinct, round; middle of caudal fin thickly dotted with black; maxillary not reaching orbit; head nearly 4; depth about $2\frac{3}{4}$; A. 40–42.
 - 7. *tabatinga* (Steindachner).

¹ These spots are very obscure in alcoholic specimens, while in specimens first preserved in formalin they are conspicuous and a black band replaces the silvery band of the alcoholic specimens.

cc. Anal 30-41.

i. Lateral line 40-50.

j. A silvery lateral band ending in a black caudal spot, sometimes two lateral spots in front; maxillary very short, without teeth, 2 in the eye; depth $2\frac{1}{2}$ -3; head 4-4 $\frac{1}{2}$; eye $2\frac{1}{2}$ -2 $\frac{3}{8}$ in head; D. 11, behind ventrals; A. 35-40. Lat. line 44-47. 8. *festæ* (Boulenger).

jj. A black band extends from base of caudal fin along its middle rays; maxillary extending to eye, its length at least $\frac{2}{3}$ the length of the eye, without teeth; eye $2\frac{2}{5}$ -3 in head; depth $2\frac{2}{3}$ -2 $\frac{3}{4}$; head 4; A. 34-40; scales 8 or 9-40 to 50-8 or 9; last dorsal over first anal ray.

9. *brevirostris* (Günther).

jjj. Maxillary with two small teeth, equal to eye in length; eye 2.6-2.8 in head; depth 2.7-3; head 3.5-3.6; scales 8-39 to 45-6 or 7; A. 28 or 29; a dark caudal spot, not extending to end of middle rays.

38. *emperor*, which see.

jjjj. Caudal and humeral spots generally absent; origin of dorsal over ventral; interorbital wider than eye; depth 3; head 4; scales 9-40 to 46-10; A. 26-31.

37. *cordovæ*, which see.

ii. Lateral line less than 40, except sometimes in *abramis* and *bimaculatus*.

k. Anal rays 36 or fewer, rarely as many as 39 in *bimaculatus*, maxillary with a few teeth or none.

l. Depth more than three in the length, the form long and slender; maxillary without teeth.

m. Humeral and caudal spots present, anal and ventral with broad red margins; eye $3\frac{2}{3}$ in the head, much smaller than the convex interorbital. Maxillary extending to anterior margin of eye. A. 27-31; scales 7-36-7. 27. *humilis*, which see.

mm. No caudal or humeral spots; a silvery lateral band, most distinct posteriorly; head $3\frac{1}{2}$; eye $2\frac{1}{2}$ in the head. A. 30; scales 5-35-3. Maxillary toothless. 10. *astictus* (Ulrey).

ll. Depth 3 in the length. Middle rays of caudal covered by a broad band which extends to the margin of the fin and bordered above and below by yellow; a silvery lateral band; a humeral spot; head not 4 in the length. A. 27-35. Scales 7-38-7. Maxillary with a single tooth. 23. *tæniurus*, which see.

lll. Depth less than 3 in the length; a distinct caudal spot.

n. No humeral spot; depth $2\frac{1}{2}$ -2 $\frac{3}{5}$; eye $3\frac{2}{3}$ -4 in the head; maxillary with 0-3 teeth, extending considerably beyond anterior margin of eye; a conspicuous black band on the caudal peduncle, becoming wedge-shaped on the caudal. A. 29-31. Scales 7 or 8-37 or 38-6.

11. *maximus* (Steindachner).

nn. A distinct humeral spot.

o. Maxillary long; head 3.75; depth 2.75; eye 3 in the head, $1\frac{1}{3}$ in snout, equal to interorbital; maxillary without teeth; a black humeral spot, a silvery lateral band, becoming black on the tail and extending on the caudal; origin of

dorsal over ventrals. A. 30; scales 8-37 or 38-7.

12. *moorii* (Boulenger).

oo. Maxillary extending little if any beyond origin of eye.

p. Dorsal plain.

q. Humeral spot horizontally elongate.

r. Scales in 19 or 20 rows, 10-43 to 47-8 or 9; anal 28-32. Caudal plain or with an indistinct spot; humeral spot indistinct or wanting. Dorsal distinctly behind the ventral; the pectoral reaches the ventral. Depth $2\frac{1}{2}$; head less than 4.

13. *abramis* (Jenyns).

rr. Scales in fewer than 17 rows.

s. Moderately compressed.

t. Teeth of the inner series of the premaxillary with their posterior surface convex, the denticles corresponding to the convexity arranged in a U-shaped line. Scales 6 to 8-30 to 40-5 to 8; maxillary with 0-4 teeth, extending somewhat beyond the front margin of the eye. Depth 2-2.1; head 4-4.2; eye 3 in the head. A. 27-39.

14. *bimaculatus*¹ (Linnæus).

tt. Teeth of the inner series of the premaxillary alike in front and behind, the denticles arranged in a nearly straight line; scales 6-40-6; maxillary with a single tooth, extending to below origin of pupil; depth 2.4; head 4; eye a little more than 3 in head. A. 33.

15. *orthodus* (Eigenmann).

ss. Greatly compressed. Scales 7 or 8-36 to 37-6 or 7; a humeral and caudal spot; the pectorals extend beyond

¹The statement of Steindachner that the maxillary has minute teeth along its entire edge is evidently due to a slip of the pen; *A. brevoortii* from Trinidad has the following characters:

Scales 7-37 to 40-7; very distinct humeral and caudal spots, the latter often extending to the ends of the caudal rays; an obscure silvery band. Eye $3\frac{1}{2}$; maxillary sometimes with a single tooth. A. 29-34; var. *lineatus* from the La Plata system has more or less distinct series of spots or lines following the rows.

origin of ventrals; maxillary toothless, extending somewhat beyond front margin of orbit; head $3\frac{1}{4}$ -3.5; depth $2\frac{1}{3}$ - $2\frac{1}{4}$; A. 38-41. Very greatly compressed.

16. *caucanus* (Steindachner).

qq. Humeral spot circular or vertically elongate.

u. Depth 2-2.2; scales 8 or 9-36 to 40-8 or 9; a humeral and a caudal spot; maxillary with one tooth; head 3.66; depth 2-2.2; A. 38-39; dorsal and ventral outlines equally curved.

17. *atratoensis* (Eigenmann).

uu. Body more elongate, humeral spot very conspicuous. Anal rays 38-41. A silvery lateral band, a humeral spot. Dorsal a little behind the origin of the ventrals; the anterior anal rays elongate. Maxillary extending to near the anterior margin of the eye. Depth 2.4-2.8; head 3.5; scales 8-37 to 40-10.

18. *stilbe* (Cope).

pp. Dorsal with a broad, oblique, dark band across the middle, or plain. Scales 8-39-7; maxillary extends a little beyond the origin of the eye; D. 11; A. 31; depth $2\frac{3}{4}$; head $3\frac{3}{4}$.

19. *bartlettii* (Günther).

aa. Anal rays 26-29, rarely 31.

v. A series of seven deep brown longitudinal bands. Maxillary extending little, if any, beyond anterior margin of eye, with one tooth. Head 3.5; depth a little more than 2 in the length. A. 27; scales 5-31-4. (See also under *bimaculatus*.)

20. *steindachneri* (Eigenmann).

vv. A single lateral band or none.

w. Caudal without vertical band.

x. Scales 28-35.

y. A caudal spot.

z. Shoulder spot horizontally oval, well defined.

A. Scales in 18 or 19 rows; A. 28-32.1 13. *abramis*, which see.

AA. Scales in 11-16 rows.

14. *bimaculatus*, which see.

AAA. Scales 7-34-6. Lateral band black. Scales in 14 rows.

Dorsal fin behind the base of the ventrals. Maxillary with

1 tooth, extending a little beyond the anterior border of the eye to end of first suborbital; interorbital space much greater than the eye, very convex; eye 4 in head. Head $3\frac{2}{3}$; depth 3; A. 28. A humeral spot.

21. *wappi* (Cuv. & Val.).

AAAA. Scales 7-36-7; maxillary extending to eye; eye 3.66 in head, much smaller than the convex interorbital; A. 27-31; anal and ventral with broad red margins.

30. *humilis*, which see.

zz. Shoulder spot, if present, vertically elongate, sometimes faint.

B. Caudal spot band-like, continued on the middle caudal rays; scales in fewer than 15 rows.

C. A humeral spot.

D. Dorsal behind the ventrals.

E. Maxillary with 2-7 teeth; anal 27-32; depth $2\frac{1}{2}$ -3¹; head about 4; maxillary equal to eye; eye 3 in head, equal to intraorbital. Scales 7-37-6

22. *utilus nicaraguensis* Eigenmann.

EE. Maxillary with 0-2 teeth.

F. Maxillary extending distinctly beyond the anterior margin of the eye. Head 4-4 $\frac{1}{2}$; depth 2.25-3; A. 24-32; scales 6 or 7-30 to 39-4 $\frac{1}{2}$ to 6.

23. *utilus*¹ (Jenyns).

FF. Caudal band bordered by yellow above and below; head not 4 in the length; maxillary with a single tooth; A. 27-35; scales 7-38-7.

24. *tenuurus* (Gill).

FFF. A. 24-32; origin of the dorsal behind the base of the ventrals; maxillary with from 0-2 teeth, reaching anterior border of the orbit; head 4; depth 2.25-2.75; scales 7 to 9-35 to 39-6 or 7.

25. *utilus æneus* (Günther).

FFFF. Depth 3.33; head 3.66; A. 29; scales 7-37-5; maxillary long, equal to eye; eye 2.5 in the head; interorbitals 3.66.

26. *cuvieri* (Lütken).

DD. Dorsal over ventrals; snout less than 4 in head; interorbital flattish; A. 27, beginning behind the dorsal; depth 3; head 4; lat. 1. 37.

27. *petenensis* (Günther).

¹ *Rutilus jequitinhonhæ* has depth 3.

- CC. No humeral spot (Western Peru and Ecuador).
- G. Dorsal behind ventrals; snout about 4 in the head; interorbital convex. A. 26-30, beginning under last ray of dorsal; depth $3-3\frac{1}{2}$; head $3\frac{2}{3}-4$. Scales 6 or 7-36 to 40-7; 2 or 3 maxillary teeth. A silvery lateral band which may become black on the caudal.
28. *simus* (Boulenger).
- GG. Head $3\frac{1}{2}-4\frac{1}{3}$; depth $2\frac{3}{4}-3$; interorbital much more than diameter of the eye. Maxillary terminates below the anterior margin of the eye, with 2 teeth; origin of dorsal behind the ventrals. A. 26-30; scales 6-35 to 37-6 to 8.
29. *peruanus* (Müller & Troschel).
- BB. Caudal spot not continued on the middle rays.¹
- H. Scales in 15 rows, 7-36-7; A. 27-31; depth more than 3 in the length; eye 3.66 in the head, much smaller than the convex interorbital; a humeral spot and a caudal spot.
30. *humilis* (Günther).
- HH. Scales in 10-14 rows; lateral line 34-38.
- I. Head 4 or less than 4 in the length.
- J. A humeral spot; maxillary reaching anterior border of eye, not to end of first suborbital; head 3.75-4; depth 2.4-2.7; A. 23-28; scales $6\frac{1}{2}$ or $7\frac{1}{2}-34$ to 37-5 $\frac{1}{2}$ to 6 $\frac{1}{2}$. Two or three maxillary teeth.
31. *fischeri* (Steindachner).
- JJ. Maxillary ceases in front of the vertical from the pupil, and end of first suborbital. Dorsal considerably behind origin of ventrals; pectorals reaching beyond ventrals. Eye about equal to the slightly convex interorbital, 3 in the length of the head. Depth $2\frac{3}{4}$; head $3\frac{2}{3}$; A. 26; scales $6\frac{1}{2}-37$ or 38-5; a humeral spot.
32. *carolinæ* (Gill).
- II. Head 4 or less in the length. Scales $5\frac{1}{2}-35-4$. Anal, dorsal and caudal fins with red markings. Caudal and humeral spots indistinct. Head 4.2; depth 3.75; A. 25-29.
33. *phænicopterus* (Cope).
- yy. No caudal spot;² a humeral spot.
- K. Maxillary with three small teeth; eye 2.3 in head, snout 4.5, the flattish interorbital 3; depth 2.66; head 3.6; A. 28; scales 5-35-4; a silvery lateral band, a vertical humeral spot.
34. *megalops* (Eigenmann & Ogle).

¹ Not examined in *carolinæ* and *humilis*.

² Not stated for *bahiensis*.

- KK*. Maxillary with numerous minute teeth, extending beyond the front of the orbit. Snout shorter than eye. Eye 2.8-3. A. 29-30; scales 5 or 6-32 or 33-4 to 5. Head 3.6; depth $2\frac{1}{4}$ - $2\frac{1}{2}$; humeral spot elongate horizontally. 35. *bahiensis* (Steindachner).
- KKK*. Maxillary without teeth. Silvery band not edged with green above; origin of dorsal between ventral and anal; pectorals to origin of ventrals, ventrals nearly to anal. Head $4\frac{3}{4}$; depth $3\frac{1}{2}$; eye $2\frac{3}{11}$ in head; D. 10; A. 27; scales 5-37-3. 36. *alburnus* (Hensel).
- xx*. Scales 9-40 to 46-6-8; longitudinal series of scales 14-17. Caudal and humeral spots generally absent; origin of dorsal over root of ventrals. Width of interorbital greater than the diameter of the eye. Head 4; A. 26-30. Interorbital very convex, $2\frac{2}{3}$ in head; eye equals snout, $3\frac{2}{3}$ in head; depth of caudal peduncle about $\frac{1}{3}$ of the depth. 37. *cordovæ* (Günther).
- xxx*. Scales in 15 or 16 rows, 8-39 to 45-7; A. 28 or 29; head 3.6 or 3.5; depth 2.7-3; eye large, 2.6-2.8; interorbital 3.25 in head; maxillary as long as eye, with two narrow teeth; dorsal behind origin of ventrals; humeral spot faint; caudal spot distinct, not continued on middle rays. 38. *emperador* (Eigenmann & Ogle).
- aaa*. Anal rays 16-25, rarely 26 and 27 in *fasciatus* and *æneus*; 3 to 5 series of scales below the lateral line in all but *æneus* (6 or 7) and *fasciatus* ($4\frac{1}{2}$ -7). Caudal without black cross band.
- L*. Maxillary without teeth; two or three scales below the lateral line.
- M*. No caudal spot.
- N*. Depth 4.7 in the length; longitudinal series of scales 12. A broad silvery lateral stripe; no caudal spot. Maxillary toothless, rather wide, extends little beyond anterior border of the orbit. Head 4.2; depth 4.7; A. 25. 39. *longior* (Cope).
- NV*. Depth 2.5-3.5 in the length.
- O*. A silvery lateral band sharply edged above with a dark band. Dorsal fin a little behind the ventrals. The pectorals not entirely reaching the ventrals, the ventrals reaching the anal. Head 3.8; depth $3-3\frac{3}{4}$; scales 5-32-3. A. 21-22. 40. *copei* (Steindachner).
- OO*. The broad silvery lateral band not edged above with dark. Maxillary extending nearly to the front margin of the eye; anterior dorsal and anal rays elongate. Head 4.4; depth $3\frac{1}{7}$; scales 4-35-3; A. 19. 41. *diaphanus* (Cope).
- OOO*. The narrow silvery band edged with greenish above. Origin of the dorsal just behind the ventral; the pectoral reaches to the middle of the base of the ventral. Head 3.4-3.75; depth 2.8-2.86; A. 24-25; scales 5-32 or 33-3. 42. *collettii* (Steindachner).
- LL*. Maxillary with teeth.
- P*. Middle caudal rays black.
- Q*. One to three teeth in the maxillary.

- R.* A. 18-25. A silvery-gray lateral band, a dark caudal spot fading out forward. Usually a humeral spot. Maxillary with two small teeth. Head 4; depth $2\frac{3}{4}$ -3; scales 7 or 8-37 to 40-3; eye 3 in head. 43. *mexicanus* (Filippi).
- RR.* A. 24-27. Origin of the dorsal behind the base of the ventrals; maxillary toothless, or with one or two teeth, reaching anterior border of the orbit. Head 4; depth $2\frac{1}{4}$ - $2\frac{3}{4}$; scales 7 to 9-35 to 39-6 or 7. 25. *æneus* (Günther).
- RRR.* A. 18-25. A dark caudal spot extending to the end of some of the rays and fading out anteriorly; a silvery lateral band; an indistinct humeral spot; ventral and pectoral fins with red. Head 4, longer than its depth at the occiput; depth $2\frac{1}{2}$ -3; scales 5 or 6-32 to 40- $4\frac{1}{2}$ to 6 rarely 7. 44. *fasciatus* (Cuvier).
- RRRR.* A. 25-30; depth 2.6-2.66. 23. *rutilus*.
- RRRRR.* A. 3.16-19. Three or four scales below the lateral line. Head $4-4\frac{1}{3}$; depth $2\frac{1}{2}$ -3; scales 5-35 to 37-3 or 4. A. 3, 16-19. 45. *fasciatus iheringii* (Boulenger).
- QQ.* Numerous minute teeth on the maxillary which extends either a little or distinctly behind the front margin of the orbit. Eye small 3.5-4 in the head. A vertically elongate humeral spot and a longitudinal caudal stripe extending to the end of the rays and fading out anteriorly. Head $3\frac{1}{4}$ - $3\frac{3}{4}$; depth $3-3\frac{1}{2}$; scales 5-33-4. A. 16-18. 46. *jenynsii* (Steindachner).
- PP.* Middle caudal rays not black.
- S.* Scales in lateral line 34-38.
- T.* A. 23-28; depth 2.4-2.7; scales $6\frac{1}{2}$ or $7\frac{1}{2}$ -34-37- $5\frac{1}{2}$ - $6\frac{1}{2}$. 31. *fischeri*, which see.
- TT.* A. 19 or 20.¹ Almost colorless; caudal rays sometimes dusky, a grayish lateral band. Pectorals reaching $\frac{2}{3}$ to ventrals, ventrals $\frac{2}{3}$ to anal. Maxillary, with two teeth, reaching to eye. Head 4; depth 3.2-3.75; scales 4 or 5-35 to 38-4. 47. *mænkhausi* (Eigenm. & Kennedy).
- TTT.* Anal 17-18. Yellowish above, white on the sides; lateral band plumbeous above, silvery below, a plumbeous humeral spot. Head $4\frac{1}{4}$ to $4\frac{1}{3}$; eye $2\frac{1}{2}$ in head; depth 3.2-1.6. Lateral line 34-36. Dorsal band, large part of anal, the body near it and the median spot of the caudal more or less red. 48. *rubropictus* (Berg).
- TTTT.* A. 18; scales 37 or 38; depth $3\frac{1}{5}$; head $4\frac{1}{5}$; plumbeous, fins dusky; pectorals reaching ventrals; ventrals nearly to anal; caudal lobes rounded; snout blunt, lower jaw distinctly shorter than upper; a faint humeral spot. Mouth very small, maxillary not reaching eye; eye $3\frac{1}{2}$ in head, interorbital very convex, less than 3 in head; depth of caudal peduncle little less than half the greatest depth. 49. *eigenmanni* Evermann & Kendall.

¹ 26 in one specimen.

SS. Scales 5-31-3. Silvery lateral band; a diffuse caudal spot; no humeral spot. Head $3\frac{1}{2}$; depth $2\frac{3}{4}$. A. 19. 50. *paucidens* (Ulrey).

15. ASTYANAX RUTILUS (Jenyns).

(Plate XXXIV, Fig. 4.)

Tetragonopterus rutilus Jenyns, Zool. Beagle, Fishes, 125, pl. 23, fig. 2, 1842; Steind., Ichthyol. Notizen, IX, 10, pl. ii, figs. 2 and 3, 1869 (Montevideo); Hensel, Wiegmann Archiv, 1870, 80; Steind. Süßw. südöstl. Bras. III, 575, pl. ii, figs. 1 and 2, 1876 (Rio Parahyba; Rio Doce; Montevideo; Rio de Janeiro; Rio Jequitinhonha; Xamapa, Mexico); Steind. Fischf. Cauca und Flüsse bei Guayaquil, 22, 1880 (Cauca); Boulenger, Proc. Zool. Soc. Lond., 1887, 281 (Canelos); Boul., Ann. & Mag. Nat. Hist. XIV, 173, 1887; E. and E., Proc. U. S. Nat. Mus. XIV, 1891, 52 (Rio Grande do Sul); Cope, Proc. Am. Philos. Soc. 1894, 87 (Rio Grande do Sul); Ulrey, Ann. N. Y. Acad. Sci. VIII, 280, 1895; Perugia, Ann. Mus. Civ. Storia Nat. Genova, Ser. 2a, X, 44, 1891; (Resistencia & Laguna Ibera; Candelaria; Buenos Aires); Eigenm., Ann. N. Y. Acad. Sci. VII, 633, Feb. 1894 (Rio Grande do Sul); Lahille, Revista Museo de la Plata, VI, 7, 1895 (Puerto Viejo; Arroyo de Gato; Doña Flora; Dock Central; Isla Santiago; Punta Lara); Boulenger, Boll. Mus. Torino XII, 1897 (Caiza; Mission de San Francisco; San Lorenzo) and XIII, 1898, 2 (Rio Peripa; Rio Zamora; Rio Santiago); Eigenmann & Norris, Revista Museo Paulista, 357, 1900 (Taubaté; Rio Tieté).

Tetragonopterus teniatus Jenyns, Zool. Beagle, Fishes, 126, 1842; C. & V., XXII, 145, 1848; Müll. & Trosch., Fische Brit. Guiana, 635, 1848 (Ditches and swamps near coast); Günther, Cat. Fish. Brit. Mus. V, 329, 1864.

Tetragonopterus fasciatus C. & V., XXII, 149, 1848 (not of Cuvier); Günther, Cat. Fish. Brit. Mus. V, 22, 1864 (not synonymy) (Brazil; West Ecuador; Huamachal; Rio Guacalate; Rio Chisoy; Vera Paz, Mexico; Cordova; Central America; Guatemala); Günther, Ann. & Mag. Nat. Hist., July, 1880 (La Plata); E. & E. Proc. U. S. Nat. Mus., XVI, 1893, 55; Vaillant, Bull. Mus. d'Hist. Nat. 1897, 221 (Chagres); id. l.c. 1899, 155 (Carnot).

Tetragonopterus scabripinnis Kner (not Jenyns), Characinen, 39, 1859 (Xamapa, Mexico ; Irisanga) ; Günther, Cat. Fish. Brit. Mus. V, 325, 1864 (in part).

Tetragonopterus microstoma Günther, Cat. Fish. Brit. Mus. V, 323, 1864 ; Günther, Ann. & Mag. Nat. Hist. July, 1880 (Rio Plata).

Tetragonopterus æneus, Hensel (not Günther) ; Wiegmann, Archiv. 1870, 87 (Southern Brazil).

Tetragonopterus jequitinhonhae Steind., Süßw. Südöstl. Bras., III, 27, pl. ii, fig. 3, 1876 (Jequitinhonha) ; E. & E., Proc. U. S. Nat. Mus., XIV, 1891, 52 ; Ulrey, Ann. N. Y. Acad. Sci. VIII, 280, 1895 ; Eigenmann & Norris, Revista Museo Paulista, 357, 1900 (Piracicaba).

Habitat: Rio Negro, Patagonia to Mexico, in all streams of the eastern slope of South America ; Western Ecuador.

Of this species Steindachner says: "Almost every river system possesses a peculiar variety of this species ; according to age, sex, season ; according to abundance or scarcity of food ; according to the habitat in cool or clear mountain brooks or deeper stagnant waters, the outlines of the body vary, and in part also, the number of horizontal rows of scales and of the anal rays."

A single specimen has been recorded from the Rio Negro. It is preserved in the British Museum and is reproduced in fig. 4, plate XXXIV.

Order IV. HAPLOMI.

Cope, Proc. A. A. A. Sci., Indianapolis, 1872, 328 and 333 ; Gill, East Coast Fishes, 1872, 14.

"Air-bladder, if present, communicating with the digestive tract by a duct. Opercle well developed. Pectoral arch suspended from the skull ; no mesocoracoid arch. Fins usually without, rarely with a few spines ; ventrals abdominal, if present. Anterior vertebræ distinct, without Weberian ossicles." Boulenger.

The boundaries of this order are differently conceived by different authors and most of the constituent families are extralimital. It includes three families with representatives in South America. Of these, one, the Pœciliidæ, which is dominant in Central America and whose species straggle north through the temperate zone and south to Buenos Aires, is

not known to have representatives in Patagonia. The three families may be distinguished as follows :

- a.* Parietals separating the frontal from the supraoccipital; post-temporal simple; precaudal vertebræ with autogenous parapophyses.
 - b.* Margin of the upper jaw formed by the premaxillaries and the maxillaries; basis cranii simple; no adipose dorsal fin. *Galaxiidae.*
 - bb.* Margin of the upper jaw formed by the premaxillaries only; basis cranii double; adipose dorsal fin present. *Aplocheilichthyidae.*
- aa.* Frontals in contact with the supraoccipital; precaudal vertebræ without well developed parapophyses; border of mouth formed by premaxillaries only; dorsal and anal without spines; scales cycloid, or with erect spines; no adipose fin; mouth protractile; ventral fins if present with 5-7 rays. *Poeciliidae.*

Family V. *GALAXIIDÆ*.

Galaxia Müller, Abhandl. Akad. Wiss. Berlin, 1844, 187.

Galaxidæ Günther, Cat. Fish. Brit. Mus. VI, 208, 1866.

This family consists of two genera,¹ *Neochanna* with a single species inhabiting New Zealand, where it sometimes burrows in damp clay some distance from water, *Galaxias* with 26 recognized species, of which six are found in southern South America or adjacent islands, two at the Cape of Good Hope, and the remainder in New Zealand, Tasmania and Australia. One of them, *attenuatus*, is probably common to American, Australian and New Zealand waters. The species range from the ocean to an elevation of 6,000 feet. Some are evidently land-locked, while others descend to the sea to spawn.

The *Galaxias* of the Cape of Good Hope is the only type of fishes south of the tropic of Capricorn in Africa that is not found north of it.

Neochanna is distinguished from *Galaxias* by the absence of ventrals.

9. *GALAXIAS* Cuvier.

Galaxias Cuvier, Règne Animal, II, 183, 1817 (*truttaceus*).

Mesites Jenyns, Voy. Beagle, Fishes, 118, 1842, sp.

Austrocobitis Ogilvie, Proc. Linn. Soc., New South Wales, XXIV, 1899, 158, (*fide* Regan).

Boulenger (Nature, Nov. 27, 1902) says concerning *Galaxias*: "Most text-books and papers discussing geographical distribution have made much of the range of a genus of small fishes, somewhat resembling trout,

¹ *Cromeria* from the White Nile has been shown to be not related to the *Galaxiidae*.

the *Galaxias*, commonly described as true fresh-water forms, which have long been known from the extreme south of South America, New Zealand, Tasmania and southern Australia. The discovery, within the last few years, of a species of the same genus in fresh water near Cape Town, whence it had previously been described as a loach by F. de Castelnau, has added to the interest, and has been adduced as a further argument in support of the former existence of an Antarctic continent. In alluding to this discovery, when discussing the distribution of African fresh-water fishes in the introduction to my work 'Les Poissons du Bassin du Congo,' in 1901, I observed that, contrary to the prevailing notion, all species of *Galaxias* are not confined to fresh-water, and that the fact of some living both in the sea and in rivers suffices to explain the curious distribution of the genus; pointing out that in all probability these fishes were formerly more widely distributed in the seas south of the tropic of Capricorn, and that certain species, adapting themselves entirely to fresh-water life, have become localized at the distant points where they are now known to exist. Although as recently as October last the distinguished American ichthyologist D. S. Jordan, wrote (*Science*, XIV, p. 20): 'We know nothing of the power of *Galaxias* to survive submergence in salt water, if carried in a marine current,' it is an established fact, ascertained some years ago by F. E. Clarke in New Zealand and by R. Vallentin in the Falkland Islands, that *Galaxias attenuatus* lives also in the sea. In New Zealand it periodically descends to the sea, where it spawns, from January to March and returns from March to May. In accordance with these marine habits, this species has a much wider range than any of the others, being known from Chile, Patagonia, Tierra del Fuego, the Falkland Islands, New Zealand, Tasmania, and southern Australia.

"I now wish to draw attention to a communication made by Captain F. W. Hutton in the last number of the Transactions of the New Zealand Institute (XXXIV, p. 198), 'On a Marine *Galaxias* from the Auckland Islands.' This fish named *Galaxias bollansi*, was taken out of the mouth of a specimen of *Merganser australis* during the collection excursion to the southern islands of New Zealand made in January, 1901, by His Excellency the Earl of Ranfurly.

"It is hoped that by giving greater publicity to these discoveries the family *Galaxiidae* will no longer be included among those strictly confined to fresh waters, and that students of the geographical distribution of animals

will be furnished with a clue to a problem that has so often been discussed on insufficient data."

The species of this genus recorded from Patagonia have received elaborate consideration from Smitt. He found that the young differs greatly from the adult and that three stages may be distinguished, "alevins," less than 45 mm., "fretins," about 50 mm., and adult, over 60 mm. Species based on these larval stages are scarcely recognizable. The difference between the alevins and the fretins of the same species is greater than the differences between two adult species. The only character distinguishing the species in all ages is the length of the lower jaw in relation to the distance of the dorsal from the tip of the snout.

He distinguishes the two species recognized by him as follows:

- a.* Head 18.8–20.1 per cent. of the length; distance of origin of dorsal from tip of snout 72–74.8 per cent. of the length; distance of origin of ventrals from tip of snout 48.5–52.1 per cent. of the length; pectoral 11; A. 13–15; lower jaw 9.3–10.2 per cent. of the length from tip of snout to dorsal. *maculatus.*
- aa.* Head 22.4–26.6 per cent. of the length; distance of origin of dorsal from tip of snout 53.8–56.6 per cent. of the length; P. 13–15; A. 9–12; lower jaw 12.9–16.3 per cent. of the distance from tip of snout to dorsal. *alpinus.*

The color of the alevins of both species is uniform yellowish or gray. In the alevins of *maculatus* a series of pigment cells follows the dorsal border posteriorly; another follows the ventral border and alimentary canal; another series along the lateral line, another along the upper margin of the notochord; a black bar at base of pectoral; a black spot at upper angle of preopercle and others on snout and top of head.

During the fretin stage the color of the two species is alike and remains so till the species has reached a length of about 8.5 cm.

More recently Regan, Proc. Zool. Soc. London, 1905, II (April 1906), considered the fretins of Smitt as a distinct species, *gracillimus* of Canestrini. Smitt's *alpinus* he considers in part *attenuatus*, in part *maculatus* and in part *platei*.

Regan defines six American species of which *alpinus* is confined to the alpine lakes of Hardy Peninsula, Tierra del Fuego, and *smittii* to the Falkland Islands. The remaining four are distinguished as follows:

- a.* Six or seven branchiostegals; caudal emarginate; origin of anal opposite or slightly posterior to that of the dorsal.
- b.* Origin of ventral equidistant from tip of snout and base of caudal or nearer the former.

- c. Length of head 5 (young) to $6\frac{1}{2}$ (adult) in the length; depth $5\frac{1}{2}$ –10; snout a little longer than eye (in the adult), smaller than interorbital; origin of ventral equidistant from tip of snout and base of caudal; depth of caudal peduncle $\frac{1}{3}$ to 2 in its length; upper parts of head and body finely punctate with blackish and spotted or marbled with dark purplish. Recorded specimens 55–170 mm. 16. *attenuatus*.
- cc. Length of head 7 – $7\frac{1}{2}$ (young) in the length; depth 10–12; snout a little shorter than eye, less than interorbital; origin of ventrals nearer tip of snout than base of caudal; caudal peduncle $2\frac{1}{2}$ times as long as deep; some small blackish spots on the head and on the upper part of the body; a line of black dots along the middle of the side and one at the base of each of the unpaired fins. Recorded specimens reaching a length of 55 mm. *gracillimus*.¹
- bb. Origin of ventral nearer to base of caudal than to tip of snout.
- d. Maxillary extending to below anterior margin of eye or slightly beyond; depth 6–8; head $4\frac{1}{2}$ – $5\frac{3}{4}$; snout nearly as long as eye which is $3\frac{1}{2}$ – $4\frac{1}{3}$ in the head; interorbital $2\frac{3}{8}$ –3; jaws equal; origin of ventral equidistant from middle of pectoral and origin of anal; caudal peduncle $1\frac{1}{2}$ –2 times as long as deep; numerous irregular blackish spots. Recorded specimens 73–120 mm. 17. *maculatus*.
- aa. Eight or nine branchiostegals; caudal truncate or emarginate; origin of anal behind that of dorsal; origin of ventral considerably nearer to base of caudal than to tip of snout; depth 5–6; head $4\frac{1}{4}$ – $4\frac{3}{4}$; snout longer than eye, which is 5 – $7\frac{1}{2}$ in head; interorbital $2\frac{1}{2}$ – $2\frac{3}{8}$; jaws equal; maxillary extending beyond origin—frequently to middle of eye; caudal peduncle as long as deep or a little longer; head, body and fins covered with numerous irregular dark spots. Recorded specimens 49–300 mm. 18. *platei*.

16. GALAXIAS ATTENUATUS (Jenyns).

Only the Patagonian synonymy and bibliography are given. The species is also found in Tasmania, Australia, New Zealand.

Mesites attenuatus Jenyns, Voyage Beagle, Fishes, 121, pl. xxii, fig. 5, 1842. (Bay Islands, New Zealand.)

Galaxias attenuatus Günther (in part), Cat. Fish. Brit. Mus., VI, 210, 1866 (Falkland Islands; Peru?); Günther, Zool. Coll. H. M. S. Alert, 21, 1881 (Puerto Bueno); Vaillant, Miss. Scient. Cap Horn, Poiss. C. 19, 1888 (Orange Bay); Perugia, Ann. Mus. Civico Storia Nat. Genova, (2a), X, 54, 1891 (Lake and River of Porto Cook); Philippi, Verh. Deutsch. Wiss. Ver. Santiago, Chile, III, 21, 1895. Delfin, Catalogo Peces Chile, 33, 1901 (Chiloe); Dollo, Voy. Du S. Y. Belgica, pl. x, fig. 5.

Galaxias maculatus (non Jenyns) Richardson, Voy. Erebus and Terror, 75, pl. xvii, figs. 14–117, 1847 (Falkland Islands); Smitt, Bih. Svenska Akad. Handl. XXVI, IV, No. 13, 1901, p. 21, pl. ii, figs. 5–8 (Rio Pescado and Ultima Esperanza).

¹ This is undoubtedly the young of *attenuatus*.

Mesites gracillimus Canestrini, Arch. Zool. Anat. Fisiol. III, 1864, 100, tav. 4, f. 2. (Chile).

Galaxias gracillimus Günther, Cat. Fish. Brit. Mus. VI, 213, 1866; Philippi, Verh. Deutsch. Wiss. Ver. Santiago, Chile, III, 21, 1895; Delfin, Catalogo Peces Chile, 34, 1901; Regan, Proc. Zool. Soc., London, 1905, II, 370 (Falkland Islands).

? *Galaxias minutus* Philippi, Wiegemann's Archiv. XXIV, 1858, 309; Verh. Deutsch. Wiss. Ver. Santiago, Chile, III, 21, 1895 (Valdivia); Delfin, l. c., 34, 1901.

? *Galaxias punctatus* Philippi, Wiegemann's Archiv., XXIV, 1858, 310; Verh. Deutsch. Wiss. Ver. Santiago, Chile, III, 21, 1895; Delfin, l. c. (Valdivia and Puerto Montt.)

Galaxias alpinus (non Jenyns) Smitt, 21, pl. ii, figs. 9-12, (Rio Azopardo; Rio Pescado; Rio Gallegos; alpine lakes of the Sierra Toro and Lago Toro basin); Delfin, l. c., 34, 1901.

Habitat: (Peru?) Puerto Montt south to Falkland Islands and Australia, Tasmania, New Zealand. No specimens were secured by Hatcher.

17. GALAXIAS MACULATUS (Jenyns).

(Plate XXXV, Fig. 4.)

Stomias variegatus Lesson, Voy. La Coquille, II, 142, 1830 (Malouines).

Mesites maculatus Jenyns, Zool. Voyage Beagle, Fishes, 119, pl. xxii, fig. 4, 1842 (Fresh-water brook in Hardy Peninsula, Tierra del Fuego; higher tributaries of the Rio Santa Cruz).

Galaxias maculatus Cuvier & Valenciennes, Hist. Nat. Poiss. XVIII, 355, 1848 (Malouines); Günther, Cat. Fish. Brit. Mus., VI, 212, 1866; Vaillant, Miss. Scient. Cap Horn, Poiss. C. 18, 1888 (Fresh-water of Orange Bay); Perugia, Ann. Mus. Civico Storia Nat. Genova (2a) X, 54, 1891 (Lake and River of Porto Cook); Philippi, Verh. Deutsch. Wiss. Ver. Santiago, III, 21, 1895; Steindachner, Zool. Jahrb., 1898, Suppl. IV, 328 (Rio Pescado near Punta Arenas); Delfin, Catalogo Peces Chile, 33, 1901 (Puerto Montt; Valdivia); Dollo, Voy. Du S. Y. Belgica, 80, pl. x, fig. 4, 1904 (Lapataia, Beagle Channel); Regan, Proc. Zool. Soc. Lond., 1905, II, 370 (Alert Bay; Orange Bay; Falkland Islands, Esterode Penco); Evermann & Kendall, Proc. U. S. Nat. Mus. XXXI, 1906, 91 (Lake Nahuel Huapi, one of the sources of the Limay River; elevation 2,500 feet).

Galaxias coppingeri Günther, Proc. Zool. Soc. London, 1881, 21 (Alert Bay); id. Zool. Coll. H. M. S. Alert, 21, 1881. (Alert Bay.)

Galaxias alpinus (non Jenyns) Smitt, Bih. Svenska Akad. Handl. XXIV, IV, No. 5, 1898, p. 56, pl. v, figs. 40-40a.

Habitat: Falkland Islands, Tierra del Fuego, Patagonia.

18. GALAXIAS PLATEI Steindachner.

(Plate XXXV, Figs. 1, 2, 2a, 3 and 3a.)

Galaxias platei Steindachner, Zool. Jahrb., 1898, Supplement IV, Zweites Heft, 329 (Rio Pescado near Punta Arenas); Delfin, Catalogo Peces Chile, 34, 1901.

Galaxias alpinus (part) Smitt, Bih. Svenska Akad. Handl. XXVI, IV, No. 13, p. 9, pl. iii, 1901.

? *Galaxias grandis* Philippi,¹ Verh. Deutsch. Wiss. Ver. Santiago, Chile III, 19, 1893; Delfin, Catalogo Peces Chile, 33, 1901 (Punta Arenas).

? *Galaxias delfini* Philippi, Verh. Deutsch. Wiss. Ver. Santiago, Chile III, 19, 1893; Delfin, Catalogo Peces Chile, 33, 1901 (Punta Arenas).

? *Galaxias titcombi* Evermann & Kendall,² Proc. U. S. Nat. Mus. XXXI, 1906, 92 (Rio Traful, Argentina).

¹ Philippi described two species of *Galaxias* as follows:

Galaxias grandis Philippi, p. 19, based on a specimen shrivelled by strong alcohol and from which all fins but the caudal had been removed, from a lake north of Punta Arenas. Length without caudal 292 mm., with caudal 330 mm.; depth 3.4 in the length, width 3.56; depth of caudal peduncle 10.8, its width 32.4 in the length; head 4.5. Head low, flat above and little arched; mouth small, eye 9 + in the head; four ridges on preopercle. Dorsal profile more strongly arched than in other species of *Galaxias*, ventral profile but little arched. Head light gray, body yellowish, lighter below; numerous spots 1½ mm. in diameter everywhere on the body, fainter ones on upper part of head.

Galaxias delfini Philippi, p. 19, based on a specimen preserved in such strong alcohol that it had to be soaked in water before its characters could be made out. From a lake north of Punta Arenas. Length without caudal 192 mm.; depth 5.8 in the length; width less than depth; depth of caudal peduncle 1.2 in the length; head a little over 4.5; depth of head greater than in *grandis* but equally flat; eye 9 in head; dorsal and ventral profiles nearly straight; base of dorsal 8.7 in the length, its height 7; back light yellow, sides light gray; back with numerous partially confluent brown spots; fins unspotted. D. 8; A. 12.

² This species, which may be distinct, was published as this report was going through the press. It was described as follows:

Head 4 in length without caudal; depth 5.94; eye 4.23 in head; snout 3.92; D. 10; A. 11; snout bluntish; eye moderate, slightly shorter than snout; dorsal outline arching slightly from occiput, thence nearly straight to front of dorsal; height of dorsal 8.56 in length without caudal, its base about 2.20 in head, the first rays when depressed not reaching tip of last rays; distance

Habitat: Chili to Punta Arenas and Rio Chico.

Twenty-four specimens, ranging from 49–96 mm., were collected by Hatcher in the Rio Chico, 15 miles below Rio Belgrano, and eight between 48 and 113 mm. near Punta Arenas. The oldest specimen is finely mottled with irregular light cross streaks. The light becomes more marked in the specimen 90 mm. long. Of two specimens 87 mm. long one is colored like the largest, the other has dark blotches and cross streaks on a yellow background. With a decrease in the size there is an irregular decrease in the amount of pigment which is in cross streaks and irregular blotches.

Family VI. *APLOCHITONIDÆ*.

Haplochitonidæ Günther, Cat. Fish. Brit. Mus. V, 381, 1864.

The family is composed of two genera, the naked *Aplochiton* with two species in Chili and Patagonia, and the scaled *Prototroctes* with three species in New Zealand, Queensland and South Australia.

The species of *Aplochiton* have also received detailed consideration from Smitt.

10. *APLOCHITON* Jenyns.

Aplochiton Jenyns, Voy. Beagle, Fishes, 131, 18.

Farionella Cuvier & Valenciennes, Hist. Nat. Poiss. XXII, 507.

Haplochiton Günther, Cat. Fish. Brit. Mus. V, 381, 1864.

SPECIES OF *APLOCHITON*.

a. D. 12–13; A. 15–16.

b. Head 22.5–25.9 per cent. of the length; width of head 11.3–12.4 per cent.; olivaceous, darker above, a series of narrow dark cross bars. 19. *zebra*.

from tip of snout to origin of dorsal about 1.46 in length without caudal; height of anal about 8.46 in same length, its base about 2.20 in head, the tips of first rays not reaching tips of last when depressed; distance from tip of snout to anal origin about 1.32 in the length without caudal; pectoral short, rounded; ventral very short, about 2.5 in head, the distance from its origin to base of pectoral about 3.35 in length without caudal, and distance from its origin to point of anal about 5.25 in same length; caudal deeply emarginate.

Color, very pale gray, slightly more dusky on back from thick minute punctulations; irregular groups of black dots on side extending not quite to belly, giving a clouded effect and the appearance of broken and entire crossbars; belly pale, with very few dots in front of ventral; a row of black dots from base of each ventral to each side of vent; fins pale, with some punctulations, head thickly punctulated above, on snout, and on side about to level of upper jaw, abruptly pale below.

Type. — A specimen 5.62 inches long, collected December 13, 1903, by Mr. John W. Titcomb, from Rio Traful near Lake Traful, Argentina.

bb. Head 20-21.1 per cent. of the length ; width of head 9.2-9.5. Lighter, no bars.

20. *tæniatus*.

19. APLOCHITON ZEBRA Jenyns.

(Plate XXXV, Figs. 5 and 5a.)

Aplochiton zebra Jenyns, Zool. of the Voyage of the Beagle, Fishes, 131, pl. xxiv, fig. 1 (Falkland Islands).

Haplochiton zebra Günther, Cat. Fish. Brit. Mus. V, 381, 1864 (Port Louis) Günther, Zool. Coll. H. M. S. Alert 1881, 22 (East Bay, freshwaters at Tom Bay) ; id. Rep. Voy. Challenger, Shore Fishes, 23, 1889 ; Smitt, Bih. Svenska Akad. Handlingar, XXVI, Afd. IV, No. 13, 1901, 1 (Rio Tres Pasos, a tributary of Lago Toro) ; Delfin, Catalogo Peces Chile 32 (Puerto Montt ; Rio Renaico ; Puerto Otuai).

Farionella gayii, Cuvier & Valenciennes, Hist. Nat. Poiss. XXII, 508, pl. 640.

Habitat : Puerto Montt, south to the Falkland Islands.

20. APLOCHITON TÆNIATUS Jenyns.

(Plate XXXV, Figs. 6 and 6a.)

Aplochiton tæniatus Jenyns, Zool. of the Voy. of the Beagle, Fishes, 132, 1842, pl. xxiv, fig. 2 (Mouth of freshwater streams, Gore Sound, Tierra del Fuego).

Haplochiton tæniatus Günther, Cat. Fish. Brit. Mus. V, 382, 1864 (Gore Sound) ; Smitt, Bih. Svenska Akad. Handl. XXVI, Afd. IV, 1, 1901 (Lago Toro) ; Delfin, Catalogo Peces Chile, 32, 1901 ; Dollo, Voy. du S. Y. Belgica, 81, 1904 (Lapataia, Beagle Channel).

Habitat : Southern Patagonia and Tierra del Fuego.

Order V. ACANTHOPTERI.

Anterior vertebræ unmodified ; no mesocoracoid and no interclavicles ; mouth border formed by premaxillary ; shoulder girdle attached to skull by a post temporal ; anterior rays of dorsal and anal usually spinous ; air bladder usually without duct.

Including the majority of marine fishes and many fresh-water species.

Suborder PERCESOCES.

Cope, Trans. Am. Philos. Soc. XIV, 456.

Ventral fins abdominal, with one spine and five soft rays; gills and mouth normal.

Two of the families of this suborder have representatives in South American fresh waters. They may be distinguished as follows:

- a.* Ribs attached to strong parapophyses; teeth small or wanting; gill rakers long and slender; pectoral fins inserted high up.
- b.* Pelvic bones free or connected with the clavicle by ligament; carnivorous; head elongate; vertebræ more than 35; dorsal spines slender, flexible, 1-8 in number; stomach not gizzard-like. *Atherinidæ.*
- bb.* Pelvic bones suspended from the postclavicles; teeth feeble or absent, limnophagous; head short and broad; vertebræ about 24; stomach gizzard-like; intestines very long. *Mugilidæ.*

The *Mugilidæ* are chiefly marine, some enter or are permanently established in fresh water, none are recorded from Patagonian fresh waters.

Family VII. *ATHERINIDÆ*.

The *Atherinidæ*, like the *Mugilidæ* are chiefly marine. A number of genera or species have become established in fresh water; thus species of *Atherina* and *Menidia* are established in fresh water in Cuba and North America. *Labidesthes* is a genus confined to the fresh waters of the eastern slope of the United States. *Lethostole* and *Chirostoma* are fresh-water fishes of Mexico. *Protistius* is found in the Peruvian Andes at an altitude of 12,000 feet; *Gastropterus* on the Pacific slope to an elevation of 7,500 feet.

Along the coast of Chili and Patagonia and entering its rivers or established in its lakes are found several species of *Atherinopsis* and *Menidia*.

The genera represented in the waters of Patagonia may be distinguished as follows:

- a.* Premaxillaries freely protractile, broad posteriorly, their edge strongly curved; jaws nearly equal, the lower slightly shorter, forming a pointed muzzle; scales large, smooth; first dorsal rounded; belly rounded; anal about 14-19; teeth minute, in bands; dorsal and anal naked. *Menidia.*
- aa.* Premaxillaries not protractile, the skin of upper jaw mesially continuous with that of the forehead; teeth simple, pointed, in villiform bands; vomer with teeth or not. *Atherinopsis.*

11. MENIDIA Bonaparte.

Menidia Bonaparte, Fauna Italica 1836 (*menidia*).

? *Chirostoma* Swainson, Fishes 1839, 243 (*humboldtianum*).

Argyrea Dekay, New York Fauna, Fishes, 141, 1842 (*notata*).

Atherinoides Bleeker, Verhand., Batav. Genootsch. Japan, XX, 40, 1853 (*vomerina*).

? *Atherinichthys* Bleeker, l. c., 40 (*humboldtianum*).

? *Heterognathus* Girard, Proc. Ac. Nat. Sci. Phila., 1854, 198 (*humboldtianum*).

? *Lethestole* Jordan & Evermann, Bull. U. S. Nat. Mus. 47, 792, 1896 (*estor*).

Eslopsarum Jordan & Evermann, Check List Fishes, 330, 1896 (*jordani*).

If only the long jawed forms of *Chirostoma* of Mexico were considered, they could readily be generically distinguished from *Menidia*. But Meek has shown that while some species have a projecting lower jaw, others have the jaws equal and still others have the upper jaw projecting. These, according to Meek, intergrade to such an extent that no generic dividing line can be drawn between Mexican species. Inasmuch as the short jawed forms appear to be true *Menidias* it is a question whether the genus *Chirostoma* should not be united with *Menidia*.

Smitt and Fowler have made out that *Menidia laticlava* is synonymous with *A. regius*. Steindachner on the other hand found that they are generically distinct.

a. Head 3.66-4.5 in the length; depth 4-4.2; D. vi-viii-i, 10; A. i, 13-14; Lat. line 75-80.

21. *mauleana*.

aa. Head 5.5-6; depth 6.6-7; D. viii, 10; A. i, 18; Lat. line 86.

22. *laticlava*.

aaa.¹ Head 5.5; depth 5.5; D. vii, 9; A. i, 16; Lat. line 68-70; eye a little more than 4.4 in head.

23. *hatcheri* sp. nov.

aaaa. Head 5; depth 8.5; D. vi-viii, 10; A. i, 18-i, 20; Lat. line 100; eye 3-5 in head, a conspicuous silvery lateral band; each scale of the back with one or more dots; origin of spinous dorsal over tips of ventrals.

patagoniensis sp. nov.

21. MENIDIA MAULEANA (Steindachner).

Chirostoma mauleanum Steindachner, Ann. Naturh. Hofmus. V, II, 1896, 213 (Pichi Laguna, a branch of Lake Llanquihue); id., Zool. Jahrb. 1898, Suppl. IV, 313.

This species is known only from the types.

¹Hatcher collected three small specimens, probably at Sandy Point (Punta Arenas), Straits of Magellan.

22. MENIDIA LATICLAVA (Cuvier & Valenciennes).

Atherina laticlava Cuvier & Valenciennes, Hist. Nat. Poiss. X, 473, 1835 (Valparaiso; Laguna de la Taguatugua); Guichenot, in Gay Hist. Chile, Zool. II, 252, 1848, and plate iv, fig. 1, 1854.

Atherinichthys laticlava Günther, Cat. Fish. Brit. Mus. III, 402 (Valparaiso; Falkland Islands; Port Louis); Cunningham, Trans. Linn. Soc. London, XXVII, 471, 1871 (Punta Arenas, Port Famine, Port Gallant, all on Str. of Magellan); Vaillant, Miss. Scient. Cap Horn, Poiss. C. 22, 1888 (Rio Pesca); Perugia, Ann. Mus. Civ. Stor. Nat. di Genova, Ser. 23, X (xxx), 620, 1891 (mouth of the Rio Negro); Delfin, Catalogo Peces Chile, 46, 1901.

23. MENIDIA HATCHERI spec. nov.

(Plate XXXVII, Fig. 4.)

Type: A single specimen 219 mm. to base of caudal. Lake Pueyrredon. Elongate; head $5\frac{1}{2}$; depth $5\frac{1}{2}$; D. VI-I, 9; A. I, 16; lat. line 68-70. Snout 3.75 in head, eye 4.4, 1.6 in interorbital; mouth small, the lower jaw included when closed; snout and premaxillary equal to length of eye; snout and maxillary equals length of snout, the maxillary not reaching the eye. Teeth in narrow bands in each jaw, persistent, those of the outer jaw slightly enlarged; no teeth on vomer.

Spinous dorsal nearer caudal than tip of snout, its origin about over tip of ventrals, its tip over anus; origin of second dorsal over second fourth of anal, its tip not reaching tip of anal. Caudal widely forked; anal emarginate, its last ray a little longer than eye, considerably longer than some of the preceding rays, its longest anterior ray equal to half the distance between tip of snout and origin of pectoral, equal to length of ventrals; ventrals reaching very little more than half way to anal; pectorals short, about $6\frac{1}{2}$ in the length, reaching half way to middle of ventrals.

A silvery lateral band, margined with plumbeous above; each scale of head and body with a band of chromatophores along the margin, those of the back more numerous than below; all the fins dusky, the membranes being densely pigmented. Scales cycloid.

12. ATHERINOPSIS Girard.

Atherinopsis Girard, Proc. Ac. Nat. Sci., Phila. VII, 1854, 134 (*californiensis*).

Basilichthys Girard, Proc. Acad. Nat. Sci. Phila. VII, 1854, 198, and U. S. Naval and Astronomical Expedition, 238, 1855 (*microlepidotus*).

The genus *Basilichthys* is distinguished from *Atherinopsis* solely on the relative length of the jaws. Girard says: "The genus *Basilichthys* will be characterized by the protrusion of the upper jaw beyond the lower." It was based on *Atherina microlepidota*, by Steindachner considered a synonym of the *Atherina regia* of Humboldt.

The *Atherinopsis* is defined as having "no palatine teeth, with both jaws equal, and the snout more or less rounded." Until specimens can be directly compared, the genus *Basilichthys* may be united with *Atherinopsis*.

There is but a single species of this genus in Patagonian waters. If, as Steindachner thinks, the species is confined to the Pacific coast from Valparaiso northward, the reference to this species south of that point may belong to *Menidia laticlava*.

24. ATHERINOPSIS REGIUS (Humboldt).

Atherina regia Humboldt, Rec. Observ. Zool. Anat. Comp. II, 187, 1835 (Callao; Lima); Cuvier and Valenciennes, Hist. Nat. Poiss, X, 474, 1835.

? *Atherinichthys regia* Smitt, Bihang Svenska Akad. Handl. XXVI, Afd. IV, No. 5, 93, pl. ix, figs. 30-31, 1898 (in part).

Atherinopsis regius Steindachner, Dk. Ak. Wiss. Wien, LXXII, 39, 1902 (Rio Tambo, South Peru).

? *Atherinopsis regia* Hatcher, these reports, Vol. I, 280, 1903 (Inlet of the Gallegos river).

Atherina microlepidota Jenyns, Voy. Beagle, Fishes, IV, 68, pl. xvi, fig. 1, 1842 (Valparaiso); Guichenot, Gay Hist. Chile, Zool. II, 253, 1848.

Basilichthys microlepidotus Girard, Proc. Acad. Nat. Sci. Phila. VII, 1854, 198; id. U. S. Nav. and Astron. Exped., 238, plate xxx, figs. 8 and 9, 1855 (Valparaiso; Mapocho, a tributary of the Maypu); Evermann & Kendall, Proc. U. S. Nat. Mus. XXXI, 1906, 97 (Lakes Nahuel Huapi and Traful; Nirihuahay, tributary of Rio Limay).

Atherinichthys microlepidota Günther, Cat. Fish. Brit. Mus. III, 403, 1861 ; Kner, Novara, Fisch. 222, 1869; ?Perugia, Ann. del Mus. Civ. di Stor. Nat. Ser. 2a, X (XXX), 620, 1891 (Mouth of the Rio Negro); Berg, Ann. Mus. Nac. Buenos Aires, IV, 28, 1895; Delfin, Catalogo Peces Chile, 47, 1901.

Atherina laticlava Cope, Proc. Am. Philos. Soc. XVII, 1878, 44 (Callao).

Habitat: (?Montevideo to) Valparaiso and northward in salt and fresh water.

No specimens of this species were collected by Hatcher. He says of it:

"One species, *Atherinopsis regia*, of particularly fine flavor, is especially common at certain seasons along the east coast. So abundant were these fish in the inlet of the Gallegos river for several days during the spring of 1898 that on one occasion they were brought in great schools by the incoming tide and left stranded in such quantities on the shingle bed of the north coast that, for a distance of twelve miles, or over, the beach extending from North Gallegos to two or three miles above Killik Aike, the shingle was covered to an average width of ten yards and to the depth often of several inches with dead fish."

Suborder PERCOMORPHI.

Cope, Proc. A. A. A. S., 1871, Indianapolis, 341.

A dominant group of fishes of fresh and especially of salt water.

Ventrals thoracic, with a spine and 4 or 5 rays; lower pharyngeals usually separate; gills 4, a slit behind the fourth; nares double on each side; scales ctenoid; post temporal slender, divided at tip and not coössified with skull; bones of jaw distinct; pectoral actinosts normal; vertebræ 24-40.

Family VIII. *SERRANIDÆ*.

Maxillary usually not sheathed by the preorbital (sheathed in Patagonian species); anterior vertebræ without transverse processes; all or most of the ribs inserted on the transverse processes when these are developed; anal spines 3; pseudobranchiæ well developed; vomer with teeth; lateral line extending to base of caudal; anal shorter than dorsal; head not everywhere covered with rough scales; second suborbital with an internal lamina supporting the globe of the eye; entopterygoid present; six or seven branchiostegals.

Of this widely distributed family, whose species are chiefly marine, two genera with five species are found in South American fresh waters. Two of the species are found in Patagonia, two others are confined to Central Chili; and the fifth is found near Buenos Aires. The genera may be distinguished by the following characters :

- a.* Two dorsals ; pectoral asymmetrical, upper rays longest ; ventrals below or a little behind base of pectoral. Tongue smooth ; scales ciliate ; vertebræ 33-35.
- b.* Maxillary with supplemental bone ; ventral below posterior edge of base of pectoral ; palatine toothed ; scales small. *Percichthys.*
- bb.* Maxillary without supplemental bone ; ventral a little behind base of pectoral ; palatine toothless ; scales larger. *Percilia.*

13. PERCICHTHYS Girard.

Percichthys Girard, Proc. Acad. Nat. Sci. Phila., VII, 1854, 197 and U. S. Naval and Astronom. Exped. 230, 1855. (*trucha*.)

Type : *Perca trucha* Cuvier & Valenciennes.

SPECIES OF PERCICHTHYS.

- a.* Depth less than length of head.
 - b.* Sides of head and body usually spotted ; highest dorsal spine less than half the length of head in adult ; scales 8 to 10-59 to 67-22 to 25. 25. *trucha*.
 - bb.* Sides of head plain ; highest dorsal spine more than half the length of head in the adult ; lateral line 66-70. 26. *vinciguerræ*.
- aa.* Depth equals length of head.
 - c.* Maxillary extending to below anterior border of eye ; 10-13 spines on lower border of preopercle. Scales 10 or 11-54 to 58-19 or 20. 27. *melanops*.
 - cc.* Maxillary extending a little beyond the margin of the eye ; 4-7 spines on the lower limb of preopercle ; scales 8-66 to 72-23. 28. *altipinnis*.

25. PERCICHTHYS TRUCHA (Cuvier & Valenciennes).

(Plate XXXVI, Fig. 3, and Plate XXXVII, Fig. 2.)

Perca trucha Cuvier & Valenciennes, Hist. Nat. Poiss. IX, 429, 1833 (Rio Negro, Chile) ; Guichenot, in Gay, Hist. Chile, Zool. II, 146, 1848 (Chile) ; id. Atl. Ichthiol. I, v, fig. 1, 1854.

Percichthys trucha Girard, Proc. Ac. Nat. Sci. Phila. VII, 1854, p. 197, and U. S. Naval and Astronom. Exped. II, 230, 1855 ; Günther, Cat. Fish. Brit. Mus. I, 61 ; Jordan & Eigenmann, Bull. U. S. Fish. Com. VIII, 427, 1890 (Santiago and Curico, Chili) ; Boulenger, Mem. Soc. Sc. Chile, IV, 10, 1894 ; id. Cat. Fish. Brit. Mus. I, 119, 1895 ;

Steindachner, Zool. Jahrb. 1898, Suppl. IV, Zweites Heft, 281 (Pichi-Laguna, an arm of Lake Llanquihue at Puerto Montt); Delfin, Catalogo Peces Chile, 58, 1901; Evermann & Kendall, Proc. U. S. Nat. Mus. XXXI, 1901, 100 (Rio Negro; Rio Limay; Lake Nahuel Huapi; Lake Traful).

Perca laevis Jenyns, Zool. Beagle, Fishes I, pl. i, 1842 (Rio Santa Cruz).

Percichthys laevis Günther, Cat. Fish. Brit. Mus. I, 61; Kner, Novara Fische II, 1865 (Valparaiso); Vaillant, Miss. Scient. Cap Horn, Poiss. C. 31, 1888 (Santa Cruz); Jordan & Eigenmann, Bull. U. S. Fish Com. VIII, 428, 1890; Perugia, Ann. del Mus. Civ. Stor. Nat. Genova, Ser. 2a, X (XXX) 609, 1891 (Tierra del Fuego; Laguna del Rio Negro; Rio Santa Cruz).

Percichthys chilensis Girard, Proc. Acad. Nat. Sci. Phila., VII, 1854, 197; id., U. S. Naval and Astron. Exped. 231, pl. xxix, figs. 1-4, 1855 (Rio de Maypu, near Santiago, Chili); Philippi, Mon. Berl. Acad. 1866, 708.

Habitat: Rio Negro and Valparaiso and southward. Four specimens were taken by Hatcher in the Rio Santa Cruz; the locality of seven others is not indicated.

The following description is based on these specimens and on 12 specimens from Santiago and Curico, Chili.

Body elongate, deepest below first dorsal spine; maxillary reaching to below pupil, or little beyond anterior border of eye, $2\frac{4}{5}$ to 3 in head. Maxillary and mandibular teeth in similar bands, broadest in front and tapering backwards; teeth on vomer in a triangular patch; palatine bands of teeth much longer than those on vomer, separated from the latter, and placed almost at right angles to them. Head covered with scales forward to the anterior nostril, a short linear naked area, always present, at or near the base of the supraoccipital keel. Scales on cheeks in twelve to fifteen irregular series; scales on opercle as large as those on body, in about six series. Eye large, $1\frac{2}{5}$ to $1\frac{3}{5}$ in snout, 5 to $5\frac{3}{5}$ in head, 1 to $1\frac{1}{2}$ in interorbital space. Mouth terminal or subterminal, the lower jaw slightly included. Profile straight or very slightly concave from tip of occipital process to premaxillary process, thence abruptly decurved.

Preorbital with strong teeth directed downward and backward, strongest in young examples, largest near posterior angle of maxillary; entire vertical margin of preopercle with fine teeth, largest below; lower mar-

gin of preopercle with larger, wider-set teeth, the anterior ones directed forward; posterior half of free edge of interopercle and lower half of subopercle with very fine teeth, which become more or less obsolete with age; opercle with a strong spine and a blunt or rounded point above it.

Gill-rakers short, chubby, about two-thirds the length of the pupil, $6 + 13$; inner side of the gill-rakers covered with short, stout teeth.

Distance of first dorsal spine from tip of snout, $2\frac{3}{5}$ in length of body. First dorsal spine less than half the length of the second, the second from one-half to two-thirds length of the third spine, which is the highest, $2\frac{1}{5}$ in the head in adult, $1\frac{3}{5}$ in young, the spines decreasing in height to the ninth; the spinous and soft dorsals connected. Caudal in the young slightly emarginate, the upper part truncate, lower rounded. First anal spine inserted under second dorsal ray, the spines graduated, the second strongest, highest ray $2-2\frac{1}{4}$ in head. Ventral inserted below the base of lower pectoral rays, the second divided ray longest, $2\frac{1}{5}$ to $1\frac{4}{5}$ in head. Pectoral 2 to $1\frac{4}{5}$ in head.

Scales of body of about uniform size, becoming very much smaller on breast and top of head. Scales strongly ctenoid on sides.

Small scales on the caudal membrane at its basal third. Anal and dorsal without scales.

Color olivaceous yellow, with peppery black dots, aggregated in spots on the back; the scales along base of dorsal and the upper half of caudal peduncle with a brownish spot at their base, spots forming more or less regular longitudinal lines; membrane of soft dorsal with minute brownish dots, aggregated in places to form rather large spots. Membrane of caudal dusky; anal with brownish dots along the middle of the membranes; pectorals and ventrals with similar, but fewer, spots. Head $3\frac{1}{2}-3\frac{3}{5}$ in length, to base of caudal; depth 4 to $4\frac{2}{5}$; D. IX-XI, 11 or 12; A. III, 8-10. Scales 9-59 to 67-17. This species reaches a length of 480 mm.

26. PERCICHTHYS VINCIGUERRÆ Perugia.

(Plate XXXVII, Fig. 3.)

Percichthys vinciguerræ Perugia, Ann. del Mus. Civ. Stor. Nat. Genova, Ser. 2a, X (XXX), 610, 1891 (Rio Santa Cruz); Boulenger, Cat. Fishes, I, 120, 1895.

Through the courtesy of Dr. R. Gestro I have received one of the

types of *Percichthys vinciguerræ* Perugia and also a specimen of nearly the same size of *P. lævis* = *trucha*. The species is very closely allied if not identical with *trucha*. The characters on which Perugia laid stress as distinguishing this species are not present in the type sent me. Other characters which readily distinguish this specimen are different according to Perugia, in other specimens of *vinciguerræ*. The only characters distinguishing the type of *vinciguerræ* sent from the specimen of *trucha* of nearly equal size are the following:

- a.* Head and sides plain in color; depth $4\frac{2}{5}$ in length to caudal; lat. l. 70 (about); highest dorsal spine more than half length of head. *vinciguerræ.*
aa. Sides of head, above line back from angle of mouth, and sides of body spotted; depth 4 in the length; lat. l. 65; highest dorsal spine less than half length of head. *trucha.*

The extent of the maxillary made use of by Perugia is not diagnostic. Taking the distance from tip of snout to end of maxillary with dividers and comparing it with distance of tip of snout from eye, it is found that in the three specimens of *trucha* collected by Hatcher and the *trucha* and *vinciguerræ* collected by the Italian expedition:

1. Hatcher specimen; maxillary reaches middle of eye.
2. Hatcher specimen; maxillary reaches to anterior margin of pupil.
3. Hatcher specimen; maxillary reaches to anterior margin of pupil.
4. *P. lævis* collected by Italian expedition; maxillary reaches posterior margin of pupil.
5. *P. vinciguerræ*; maxillary reaches to middle of pupil.

The number of spines on the lower limb of the left preopercle of the five specimens are respectively 8, 11, 8, 11, 11.

The scales in the lateral line are 61, 65, 59, 65, 70.

The greatest depth of body in the length to base of caudal is respectively 4, 4, 4, 4, $4\frac{3}{5}$, the specimen of *vinciguerræ* being distinctly more slender than the others. I am inclined to think that the depth " $3\frac{3}{4}$ " of Perugia must be a misprint for $4\frac{3}{4}$.

In a specimen collected by Hatcher with a length of 210 mm. the highest dorsal spine is equal to half the length of the head; in a specimen 160 mm. long it is equal to the head less the opercle.

Elongate slender, deepest in space between base of ventrals and first dorsal spine; maxillary reaching to below middle of pupil, 3 in the head; teeth as in *trucha*; squamation of head similar to that of *trucha* but the occipital crest and parietals striate and naked (in this specimen only?);

scales of cheek irregular in size, those near edge the smallest; opercular scales as large as those on body. Eye $1\frac{4}{5}$ in snout, $1\frac{2}{5}$ in interorbital, $6\frac{1}{5}$ in head; mouth terminal, jaws equal, profile slightly concave from middle of occipital process to tip of maxillary process.

Preorbital serrate; vertical limb of preopercle finely serrate, lower limb of preopercle with strong antrorse spines, more or less aggregated in groups of two or three.

Opercular spine as in *trucha*, subopercle and interopercle finely serrate.

Gill-rakers about $\frac{4}{5}$ the diameter of pupil, $9 + 13$.

Distance of first dorsal spine from tip of snout $2\frac{5}{7}$ in the length; fourth dorsal spine highest, more than half length of head; caudal emarginate; ventrals $1\frac{3}{5}$ in head, pectorals $1\frac{3}{4}$. Scales as in *trucha*.

Sides yellowish *without spots* aside from the chromatophores giving the darker color of the back; left dorsal and caudal very faintly spotted, other fins plain.

D. x, 11 or 12; A. III, 9; scales $7\frac{1}{2}$ to 9-66 to 70-18.

27. PERCICHTHYS MELANOPS (Girard).

(Plate XXXVI, Figs. 2, 2a and 2b.)

Percichthys melanops Girard, Proc. Acad. Nat. Sci. Phila. VII, 1854, 197 (Rio de Maypu, Chili); id., U. S. Nav. and Astron. Exped. 233, pl. xxx, figs. 1-5, 1855 (Rio de Maypu, Chili); Günther, Cat. Fish. Brit. Mus. I, 61, 1859; Jordan & Eigenmann, Bull. U. S. Fish Com. VIII, 428, 1890; Boulenger, Mem. Soc. Sc. Chile IV, 13, 1894; id., Cat. Fish. Brit. Mus. I, 120, 1895; Delfin, Catalogo Peces de Chile, (Rio Maipo, Central Chili; Colima).

Percosoma melanops Gill, Proc. Acad. Nat. Sci. Phila. 51, 1861.

Perca pocha Philippi, Arch. Wieg. 1863, 210 (Santiago, Chili).

Percichthys pocha Jordan & Eigenmann, Bull. U. S. Fish. Com. VIII, 428, 1890 (Curico, Chili).

The southernmost record for this species is Curico, Chili, about 100 miles north of the source of the Neuquen on the Pacific slope.

Body ovate, deepest below first dorsal spine. Maxillary reaching scarcely to vertical from anterior margin of orbit, 3 in head. Teeth of lower jaw in a band widest near tip, and tapering to a single series behind, some of the lateral teeth longer than the others; teeth of upper jaw in a

broader band, those of the sides not in a single series, teeth all about equal; teeth on vomer in a very narrow, crescent-shaped patch; those on palatines in a band much narrower and shorter than that on the vomer. Mouth oblique, the jaws subequal, the lower slightly included. Head scaled forward to the anterior nostril; scales on cheek in about eight series, those on opercle about as large as those on body, in about six series. Profile straight, from anterior margin of orbit to tip of occipital crest, rounded in front and behind. Eye $1\frac{1}{2}$ in snout, $4\frac{1}{2}$ to 5 in head; interorbital area a little wider than eye. Preorbital minutely serrate, the serræ weaker than in *P. trucha*. Preopercle with minute teeth on its vertical border, the teeth near the angle sometimes very much enlarged, sometimes little enlarged, more numerous than in *P. trucha*; serration of the subopercle and preopercle scarcely visible; opercular spine placed higher than in *P. trucha*, its tip sometimes incompletely two or three parted; a bluntish projection on opercle above the spine. Gill-rakers very short, about equal to one-third diameter of eye, 6 + 11. Distance of first dorsal spine from snout $2\frac{3}{7}$ to $2\frac{4}{7}$ in the length. Height of dorsal spines variable, the first always less than half as high as the second, the third or fourth dorsal spine highest, 2 to 3 in head, the spines decreasing in height to the ninth; spinous and soft dorsal connected. Caudal truncate when spread out, emarginate when closed. Anal inserted below the beginning of the soft dorsal, its spines graduated, the second thickest; highest ray about half as long as the head; ventral $1\frac{6}{7}$ in head; pectoral $1\frac{1}{2}$ to $1\frac{6}{7}$ in head.

Scales on the body of about equal size, less strongly ctenoid than in *P. trucha*, reduced on breast and head. Lateral line much more strongly curved than in *P. trucha*.

Color brownish, golden-yellow below, everywhere with brownish dots; those on the lower half of the body scattered with usually a light (blue?) center, a dusky spot at the base of each scale on the sides; all the fins dusky, with reddish brown dots; those on the base of the soft dorsal sometimes aggregated into spots. Head 3 to $3\frac{1}{4}$ in length to base of caudal; depth 3 to $3\frac{1}{4}$; D. x, 11 or 12; A. iii, 9 or 10. Scales 10 or 11-54 to 58-19 or 20.

This species reaches a length of 180 mm.

28. PERCICHTHYS ALTIPINNIS Regan.

(Plate XXXVII, Fig. 1.)

Percichthys altipinnis Regan, Revue Suisse de Zoologie 13, 390, 1905 (Rio Colorado, Buenos Aires). Dorsal x-xi-1, 11; Anal III, 8 or 9; scales 8-66 to 72-23.

Depth 3.5-3.66; head 3.6-3.75; eye 5-5.33 in the head, interorbital 4.33-4.66 in the same. Maxillary extending a little beyond the margin of the eye; preorbital finely serrate; vertical limb of preopercle finely serrate, the angle armed with 2 or 3 spines and with 4-7 antrorse spines on the lower limb; a strong spine at the opercle; 3-5 spines at the clavicle above the base of pectoral; supraclavicle fine serrate; third dorsal spine longest, measuring $\frac{4}{5}$ of the length of the head; second anal spine longest, $\frac{2}{5}$ of the length of the head. Olivaceous.

This species is known only from the types. It is the most northern of the eastern species.

14. PERCILIA Girard.

Percilia Girard, Proc. Acad. Nat. Sci. Phila., VII, 1854, 197 and U. S. Naval and Astron. Exped. 235 (*gillissi*).

Type: *Percilia gillissi* Girard.

This genus does not belong to the tropical American fauna. Nor has it been taken in Patagonian waters. Its affinities are Patagonian. Its southernmost recorded habitat is the Rio Itata directly opposite the source of the Neuquen, the northern source of the Rio Negro. I have not seen the species and have drawn on Boulenger's account of it.

29. PERCILIA GILLISSI Girard.

(Plate XXXVI, Fig. 1.)

Percilia gillissi Girard, Proc. Acad. Nat. Sci. Phila., VII, 197, 1854 (Rio de Mayo); Girard, U. S. Nav. and Astron. Exped. 236, pl. xxix, figs. 5-9, 1856 (Rio de Mayo); Günther, Cat. Fish. Brit. Mus. I, 255, 1859; Boulenger, Mem. Soc. Sc. Chile, IV, 15, 1894; Boulenger, Cat. Fish. Brit. Mus. I, 121, 1895 (Itata); Delfin, Catalogo Peces Chile 59, 1901 (Maipu and Itata; Pline).

Perca segethi Philippi, Wiegman, Arch. 1863, 211 (Santiago, Chili).

Percilia gracilis Philippi, Mb. Akad. Wiss. Berl. 1866, 708 (Rio Reine,

Santiago, Chili); Jordan & Eigenmann, Bull. U. S. Nat. Mus. VIII, 430, 1890.

Habitat: Chili from Itata to Valparaiso.

D. VIII-IX, 1, 10-11. A. III, 8-10. Scales 4 or 5-36 to 40-9 to 11; lat. line 1, 33-35.

Depth of body $5\frac{1}{4}$ to 4 times in total length, length of head $3\frac{1}{3}$ to $3\frac{1}{2}$ times. Snout slightly overlapping lower jaw, as long as the diameter of the eye, which is $3\frac{1}{2}$ to 4 times in length of head, and a little exceeds interorbital width; maxillary reaching to below anterior border of eye, the width of its distal extremity about $\frac{1}{3}$ diameter of eye; head naked above, cheeks and opercles scaly. Gill-rakers very short, 10 to 12 on lower part of anterior arch. Dorsal originating behind vertical of axilla, spinous portion once and a half to once and two thirds as long as second; third or fourth dorsal spine longest, $\frac{3}{8}$ to $\frac{2}{3}$ length of head, and longer than longest soft rays. Pectoral $\frac{2}{3}$ to $\frac{3}{4}$ length of head. Second anal spine longest. Caudal truncate. Brownish above, the scales often edged with black; yellowish beneath; young with eight or nine more or less distinct dark cross-bars and the caudal barred with blackish; lips, border of gill-membranes, pectoral and border of dorsal fins red.

This species reaches a length of 95 mm.

LIST OF NOMINAL SPECIES WITH THEIR IDENTIFICATIONS.

<i>Perca trucha</i> Cuv. & Val.,	1833,	<i>Percichthys trucha</i> .
<i>Atherina regia</i> Humboldt,	1835,	<i>Atherinopsis regius</i> .
<i>Atherina laticlava</i> Cuv. & Val.,	1835,	<i>Menidia laticlava</i> .
<i>Arius papillosus</i> Cuv. & Val.,	1840,	<i>Diplomyste papillosus</i> .
<i>Perca lævis</i> Jenyns,	1842,	<i>Perichthys trucha</i> .
<i>Atherina microlepidota</i> Jenyns,	1842,	<i>Atherinopsis regius</i> .
<i>Mesites maculatus</i> Jenyns,	1842,	<i>Galaxias maculatus</i> .
<i>Mesites attenuatus</i> Jenyns,	1842,	<i>Galaxias maculatus</i> .
<i>Mesites alpinus</i> Jenyns,	1842,	<i>Galaxias alpinus</i> .
<i>Aplochiton zebra</i> Jenyns,	1842,	<i>Aplochiton zebra</i> .
<i>Aplochiton tæniatus</i> Jenyns,	1842,	<i>Aplochiton tæniatus</i> .
<i>Petromyzon mordax</i> Richardson,	1845,	<i>Caragola mordax</i> .
<i>Trichomycterus arcolatus</i> Cuv. & Val.,	1846,	<i>Hatcheria arcolata</i> .
<i>Trichomycterus maculatus</i> Cuv. & Val.,	1846,	<i>Hatcheria maculata</i> .
<i>Trichomycterus incermis</i> Guichenot,	1848,	<i>Nematogenys incermis</i> .
<i>Farionella gayii</i> Cuv. & Val., xxii,	1849,	<i>Aplochiton zebra</i> .
<i>Geotria australis</i> Gray,	1851,	<i>Geotria australis</i> .
<i>Caragola lapicida</i> Gray,	1851,	<i>Caragola lapicida</i> .

<i>Velasia chilensis</i> Gray,	1851,	<i>Geotria chilensis</i> .
<i>Percichthys chilensis</i> Girard,	1854,	<i>Percichthys trucha</i> .
<i>Percichthys melanops</i> Girard,	1854,	<i>Percichthys melanops</i> .
<i>Percilia gillissi</i> Girard,	1854,	<i>Percilia gillissi</i> .
<i>Cheirodon pisciculus</i> Girard,	1854,	<i>Cheirodon pisciculus</i> .
<i>Galaxias minutus</i> Philippi,	1858,	? <i>Galaxias maculatus</i> .
<i>Galaxias punctatus</i> Philippi,	1858,	? <i>Galaxias maculatus</i> .
<i>Arius carcharias</i> Leybold,	1859,	<i>Diplomyste papillosus</i> .
<i>Perca pocha</i> Philippi,	1863,	<i>Percichthys melanops</i> .
<i>Perca segethi</i> Philippi,	1863,	<i>Percilia gillissi</i> .
<i>Petromyzon arwaudteri</i> Philippi,	1864,	<i>Caragola mordax</i> .
<i>Petromyzon acutidens</i> Philippi,	1864,	<i>Caragola acutidens</i> .
<i>Mesites gracillimus</i> Canestrini,	1864,	<i>Galaxias maculatus</i> .
<i>Percilia gracilis</i> Philippi,	1866,	<i>Percilia gillissi</i> .
<i>Arius villosus</i> Philippi,	1866,	<i>Diplomyste papillosus</i> .
<i>Arius squalus</i> Philippi,	1866,	<i>Diplomyste papillosus</i> .
<i>Arius micropterus</i> Philippi,	1866,	<i>Diplomyste papillosus</i> .
<i>Arius synodon</i> Philippi,	1866,	<i>Diplomyste papillosus</i> .
<i>Petromyzon macrostomus</i> Burmeister,	1868,	<i>Exomegas macrostomus</i> .
<i>Galaxias coppingeri</i> Günther,	1881,	? <i>Galaxias maculatus</i> .
<i>Percichthys vinciguerræ</i> Perugia,	1891,	<i>Percichthys vinciguerræ</i> .
<i>Galaxias delfini</i> Philippi,	1895,	? <i>Galaxias alpinus</i> .
<i>Galaxias grandis</i> Philippi,	1895,	? <i>Galaxias alpinus</i> .
<i>Chirostoma mauleanum</i> Steindachner,	1896,	<i>Menidia mauleana</i> .
<i>Macrophthalmia chilensis</i> Plate,	1897,	<i>Geotria chilensis</i> .
<i>Galaxias platei</i> Steindachner,	1901,	<i>Galaxias platei</i> .
<i>Geotria macrostoma gallegensis</i> Smitt,	1901,	<i>Exomegas gallegensis</i> .
<i>Gymnocharacinus bergii</i> Steindachner,	1903,	<i>Gymnocharacinus bergii</i> .
<i>Percichthys altipinnis</i> Regan,	1905,	<i>Percichthys altipinnis</i> .
<i>Galaxias titcombi</i> Evermann & Kendall,	1906,	? <i>Galaxias platei</i> .

THE ARCHIPLATA-ARCHHELENIS THEORY.

I. STATEMENT OF THE THEORY.

In volume IV, page 319, *et seq.*, of these Reports, Ortmann discusses von Ihering's Archiplata-Archhelenis theory from the standpoint of marine invertebrate fossils. Inasmuch as the evidence for this theory is mainly derived from the fresh-water fauna, I propose to discuss the application of the distribution of the fresh-water fishes of tropical America to this theory. Before entering into the details I shall outline the theory in von Ihering's own words,¹ culled from his resumé in Science (new series, XII, 857-864, 1900.)

"The study of the fresh-water fauna, and especially of the Unionidæ of South America, gave me as a practical result the separation of the two sub-regions 'Archiplata' and 'Archamazonia.' The first contains Chili, Argentina, Uruguay and Southern Brazil, the second central and Northern Brazil (Archibrazil) and Guyana, Venezuela, etc. (Archiguyana). Archiplata contains numerous genera of Mollusca, Crustacea, etc., that are com-

¹ Ortmann has misread von Ihering in putting the line separating Archiplata and Archhelenis in the Amazon valley. Ortmann says :

"Archiamazonas or Archhelenis were separated completely from Archiplata by a broad stretch of sea, which extended across the present continent, where is now the valley of the Amazon River, the Cordilleras not being yet formed, and thus a broad communication existed between what is now the Atlantic and Pacific Oceans." * * *

Ortmann has been led into this mistake no doubt by the probable northward extension of Archiplata along the present line of the Cordilleras to central Peru, where Archiplata most nearly approached, not Archhelenis, but the Archipelago of the northern Cordilleras more nearly associated with Archhelenis.

"Communication was possible in a certain degree between the shores of Archiplata and Archiamazonas. This fact is most plainly seen in the presence of Navidad fossils in corresponding deposits of northern Peru; the Navidad beds were apparently deposited near the northwestern extremity of Archiplata, and the Payta Tumbes beds near the southwestern extremity of Archiamazonas: at these places we have probably these two continents at their points of nearest approach to each other, and an exchange of marine forms may have been possible. The exchange, however, was rendered more difficult by climatic conditions, and especially, although possible in a certain degree between the Ecuadorian and the Chilian province, it was hard for the Caribbean and Ecuadorian fauna to migrate further south, into the Patagonian region." Ortmann, l. c.

Ortmann includes the greater part of Archhelenis, *i. e.*, Archibrazil, in Archiplata.

mon to Chili and the La Plata district, such as *Unio*, *Chilina*, *Parastacus*, *Æglea*, etc., including many species and even their parasites (*Temnocephala*), which are identical on both sides of the Andes. This contrasts sharply with the Archamazonian fauna, as tropical genera extend to Rio Plata and Rio Negro, which are completely wanting in Chili and Peru. In Ecuador, however, the Cordilleras form no such zoögeographical division, due certainly to differences in the geological history of both parts of the Andes. * * * These facts point out that the invasion of the Archamazonian element into Archiplata is quite a recent one. The intrusion of the Archamazonian element is Pliocene or post-Tertiary, and the Andes formed a barrier insurmountable to fresh-water crabs and mussels as well as to fishes, chelonians and alligators.

"It is evident that the two faunal elements of South America correspond to geographical districts which were separated by the ocean during the greater part of the Tertiary. The intermixture of the two elements, and especially the intrusion of Bolivian ants, land snails, etc., in Eastern Brazil is by no means finished, but is a fact which we observe to-day. * * *

"In relation to the ancient connection of Africa and Archamazonia I have given arguments (1890) in favor of a Mesozoic 'archiatlantic continent,' which existed during the earlier Tertiary.

"At first because of some paleontological facts noted by Schlosser, I believed that this continent could have transmitted Eocene mammals from South Africa to Europe, an idea now defended by Ameghino and Osborn; but in 1893 I modified my opinion and set forth the hypothesis that no Eocene placental mammals had existed either in Archamazonia or in Æthiopian Africa. The ancient continent uniting Archamazonia with Africa I named Archiatlantica in 1890, using in 1892 the term Helenis, and in 1893 that of Archhelenis, with the purpose of preventing confusion with the 'Atlantis' a hypothetical land bridge between South Europe and Central America proposed by Unger.

"The intimate relations between the fresh-water faunas of Africa and Brazil, and the colossal difference which exists between the fresh-water faunas of Archamazonia and Archiplata, prove that both territories during the greater part of the Tertiary were separated quite as completely as the two Americas. In this case the mammalian fauna of Patagonia may have reached Ecuador or Columbia by means of the upheaval of the Andes, but not Brazil, and both Brazil and the Æthiopian region may have been

without mammals and especially placental mammals, during the Eocene. When, toward the close of the Eocene this land-bridge was submerged, there already existed many types that have been conserved until our time. * * * Archamazonia, after the loss of the connection with Africa, consisted of Archiguyana and Archibrazil. * * * While the distribution of the existing types of mammals is a result of changes in geography during Tertiary time, the most fundamental facts in the distribution of the fresh-water fauna dates from the Mesozoic epoch. The fresh-water fauna of Chili preserved such a remnant of the Cretaceous fauna almost intact, and even the connection between the two Americas has not at all modified the South American fresh-water fauna. * * * There is a further difference in the distribution of mammals and fresh-water mussels. The former migrate on land-bridges in most directions, the fresh-water fauna generally in only one, due to the opportunity given by the currents. Thus although there was an invasion of Cyprinid fishes into Africa there was no corresponding emigration of *Æthiopian* types. * * *

"The fresh-water fauna is not only older but also much more conservative than the distribution of mammals. One of the most striking examples of this is given by the history of Africa. While the characteristic mammals are Neogene immigrants, and Lydekker proceeds quite correctly in making Africa an annex only of the Holarctic region, thus establishing his *Arctogæa*, with relation to the fresh-water fauna, Africa is a part of South America, somewhat modified by the Neogene invasion of Cyprinid fishes. If as regards mammals Africa belongs to *Arctogæa*, with relation to the fresh-water fauna it belongs to the *Archhellenic* region."

It is seen from the above that von Ihering divides South America into two distinct faunal areas, that he attributes the division to an ancient separation of the continent into *Archiplata* and *Archamazonia*, that he places the separating sea north of Uruguay and that he divides *Archhellenis* into *Archiguyana* and *Archibrazil* by the eastern Amazon valley. Derby has objected to the Uruguayan sea because there is no geological evidence for it. The fresh-water fishes demand a more southern line on the east than northern Uruguay, and, considering the fresh-water fishes only, there is no hesitation in placing the line in the La Plata-Paraguay valley and allowing it to extend to the north-west corner of *Archiplata*, wherever that may have been, probably in central Peru.

II. ICHTHYOGEOGRAPHICAL REGIONS.

America, south of the Tropic of Cancer, contains four (or five) distinct faunas. These faunas are the Transition, the Mexican, the South American and the Patagonian. Only the last two are intimately concerned with the Archiplata-Archhelenis theory.

The northernmost, or Transition Fauna, is characterized largely by intrusive elements from both the north and the south. It is found on the Atlantic slope from the tropic to the Isthmus of Tehuantepec and on the Pacific slope of this isthmus. It is of comparatively recent origin and not an independent fauna but a mixture of the advance guards of the North American and South American faunas.

The Mexican fauna is unique, and occupies a narrow strip including the valley of the city of Mexico and the Lerma basin, draining to the west, and the Rio San Juan, a tributary of the Panuco, draining to the east. While containing intrusive elements from the north, it contains none from the south, and its fauna is so distinct from either that there is slight hesitation in considering it as equivalent to the North American, South American and Patagonian faunas. It is a very old fauna, but has at no time influenced the South American fauna.

The third, the South American Fauna, is sharply divisible into the Brazilian and Andean. The Brazilian occupies the rivers from Southern Mexico to Buenos Aires and from the Atlantic to the Pacific, exclusive of the high Andes and Chili. This fauna is the richest in species in the world. From this region about 10 per cent. of all the known fishes have been recorded. The Andean, from 3,000 to 5,000 feet and over above sea level, while possessing some forms in common with the Brazilian, is quite distinct. The species inhabiting this region, while derived from the Brazilian fauna, have become so far modified that they would cause surprise if found at Manaos; those of the lower portions of the Pacific slope would not.

The Patagonian fauna, in distinct contrast to the South American, is one of the poorest in the world. It occupies the Rio Negro basin and everything lying south of it and a line joining it with Valparaiso. Its fauna is distinct from the Brazilian and has been considered in detail, pp. 227-292.

For convenience these faunal areas may be enumerated as the following "regions" of unequal value.

1. Transition.
2. Mexican.
3. Brazilian.
4. Andean.¹
5. Patagonian.

III. THE TRANSITION REGION.

While there are absolutely no North American intrusive elements in South America, a number of Mississippi Valley forms have reached as far as the Isthmus of Tehuantepec; only a *Lepisosteus*, *Carpiodes meridionalis* and possibly *Aplodinotus grunniens* extend farther.

On the Atlantic slope the North American fauna gradually gives place to or shades into the tropical fauna between the Rio Grande on the north and the Isthmus of Tehuantepec on the south. The Rio Grande fauna is distinctly northern, that of the Papaloapam on the south is as distinctly tropical, although the former contains a few southern elements and the latter a few northern ones. On the western slope, the southern element makes its appearance farther south than on the eastern and is separated from the northern realm by the Mexican fauna. The Mexican and Transition faunas have recently been made the subject of profound and exhaustive study by Meek and I can not do better than to summarize his results.

In this discussion the *Petromyzonidæ*, *Bagrinæ*, *Catostomidæ* and *Cyprinidæ*, being unquestionably derivatives from the north, are credited to the north, although some of the genera are peculiar to the Mexican or Transition regions. For similar reasons members of the *Cichlidæ*, *Characidæ*, *Pimelodinæ* et al. are considered South American, although some of the genera are peculiar to or dominant in Mexico and Central America. *Agonostomus* and the *Pæciliidæ*, which are dominant in Mexico, Central America and the West Indies, are considered Transitional, although they extend both into North America and South America.

In the Rio Grande basin on the boundary of the United States there are known to occur sixty-one species of fishes. Of this number three species, *Astyanax mexicanus*, *Cichlasoma pavonaceum* and *Herichthys cyano-guttatum*, are distinctly tropical, belonging as they do to Central or South American genera; forty-four are distinctly northern, and of the remainder, two are tropical Gobies also found on the American Gulf coast, and eleven

¹ The Titicaca basin probably should constitute a "region" distinct from the Andean north of Titicaca.

are *Pæciliidæ*, some of them distinctly northern and some distinctly southern, but none of them causing any surprise.

Farther south, near the tropic on the Atlantic side, is the basin of the Rio Panuco. Nearly half of its fauna, 15 species out of a total of 32, belongs to the northern fauna. Five species are distinctly tropical. In the following list of species from this river the northern forms are marked with an N, the southern with an S and the Mexican with an M, the transition forms with a T. Marine derivatives are marked Me. The Rio Panuco is on the same degree of latitude north of the equator that the Parahyba is south. The Parahyba harbors over 50 species, all of them equatorial; of the 32 found in the Panuco less than 16 per cent. are equatorial.

THE PANUCO SYSTEM (after Meek).

- N *Lepisosteus osseus* (Linnæus).
- N *Lepisosteus tristæchus* (Bloch & Schneider).
- N *Ictalurus furcatus* (Le Sueur).
- N *Ictalurus punctatus* (Rafinesque).
- N *Ameiurus australis* Meek.
- N *Ameiurus mexicanus* Meek.
- N *Carpiodes tumidus* Baird & Girard.
- N *Carpiodes labiosus* Meek.
- N *Algansea tincella* (Cuvier & Valenciennes).
- N *Hybognathus rasconis* (Jordan & Snyder).
- N *Aztecula mexicana* Meek.
- N *Notropis forlonensis* Meek.
- S *Astyanax mexicanus* (Filippi).
- N *Dorosoma exile* Jordan & Gilbert.
- N *Signalosa mexicana* (Günther).
- N *Fundulus heteroclitus* (Linnæus).
- T *Cyprinodon eximius* Girard.
- T *Gambusia affinis* (Baird & Girard).
- M *Goodea toweri* Meek.
- M *Goodea atripinnis* Jordan.
- M *Platyæcilus variatus* Meek.
- T *Pæcilia latipunctata* Meek.
- T *Pæcilia sphenops* Cuvier & Valenciennes.
- T *Molienesia latipinna* Le Sueur.

T *Xiphophorus montezumæ* Jordan & Snyder.

Me *Pomadasys templei* Meek.

S *Cichlasoma steindachneri* Jordan & Snyder.

S *Cichlasoma bartoni* (Bean).

S *Herichthys cyanoguttatum* (Baird & Girard).

S *Neotroplus carpintis* Jordan & Snyder.¹

T *Philypnus dormitor* (Lacépède).

T *Chonophorus taiasica* (Lichtenstein).

This number of species was taken from near tide level to an elevation of almost 2000 feet.

On the Pacific slope the Rio Presidio, a short, insignificant stream, at Mazatlan is near the tropic. North of it no South American elements are found.

Its fishes are :

T *Pæcilia butleri* Jordan.

T *Pæcilia presidionis* Jordan & Culver.

Me *Siphostoma starksi* Jordan & Culver.

Me *Thyrina crystallina* Jordan & Culver.

T *Agonostomus monticola* Bancroft.

S *Cichlasoma beani* (Jordan).

T *Philypnus dormitor* (Lacépède).

T *Dormitator maculata* (Bloch).

T *Eleotris pictus* Kner & Steindachner.

T *Chonophorus taiasicus* (Lichtenstein).

Me *Achirus mazatlanus* (Steindachner).

Me *Achirus fonsecensis* (Günther).

Only *Cichlasoma beani* is distinctly tropical American. *Agonostomus* is Central American ; the rest are types that would cause no surprise anywhere in a coastwise stream between the United States and South America.

The Rio Presidio, the Rio Mezquital to the south and the Rio Yaqui to the north, are on the slope of the Sierra Madre opposed to the slope drained by the Rio Grande. Confining ourselves for the present to the consideration of replacement of the northern by the southern fauna, we shall return to a comparison of their fauna with that of the Rio Grande.

¹ This species is included in the synonymy of the one preceding it in the systematic part of this report.

The Rio Mezquital south of the Presidio contains :

- N *Ameiurus pricei* (Rutter).
- N *Pantosteus plebeius* (Baird & Girard).
- *N *Moxostoma austrinum* Bean.
- N *Hybognathus episcopus* (Girard).
- N *Leuciscus nigrescens* (Girard).
- N *Notropis ornatus* (Girard).
- M *Characodon garmani* Jordan & Evermann.
- *M *Characodon fuscidens* Jordan & Gilbert.
- T *Cyprinodon latifasciatus* Garman.
- *M *Chirostoma mezquital* Meek.
- N *Etheostoma pottsii* (Girard).

As Meek points out, all but three of these species (marked *) belong to the Rio Grande basin and were probably captured from it. There are no distinctly South American elements in this river system as far as examined; it belongs to the north. But no collections have been made below the Mexican plateau and the tropical elements would naturally occur in the lowlands.

Skipping the Rio Grande de Santiago and its tributary the Lerma, whose basin embraces the greater part of the Mexican plateau, the Rio Balsas belongs distinctly to the transition zone containing *Tetragonopterus mexicanus* and *Cichlasoma istlariius* as (S) South American intrusives; *Istlariius*, *Aztecula* and *Notropis* as (N) North American intrusives, the first two of which have become generically distinct from their North American relatives and might therefore be classed as transition genera. The rest are transition genera (T) with the one exception of the Mexican *Goodea*.

This river is almost equal in size to the Lerma. It contains only about one-fourth as many fishes. Its basin is larger than the basin of the Panuco. It was fished from about 1400 feet to 6000 feet in elevation. In this area the number of species is less than half the number found in the Panuco.

- N *Istlariius balsanus* Jordan & Snyder.
- N *Aztecula vittata* (Girard).
- N *Notropis boucardi* (Günther).
- S *Astyanax mexicanus* (Philippi).
- T *Gambusia gracilis* (Heckel).
- M *Goodea whitei* Meek.

- T *Platyæcilus nelsoni* Meek.
- T *Pæcilia sphenops* Cuvier & Valenciennes.
- T *Melaniris balsanus* Meek.
- T *Agonostomus monticola* (Bancroft).
- S *Cichlasoma istlanum* (Jordan & Snyder).
- T *Chonophorus taiasicus* (Lichtenstein).

Near the Isthmus of Tehuantepec, on the Atlantic side, is the basin of the Papaloapam with the following species. In this river the northern element has approached the vanishing point, while the southern element is increasing. Collections were made from tide level to an elevation of about 3500 feet.

- Me *Galeichthys aguadulce* Meek.
- S *Rhamdia oaxacæ* Meek.
- S *Rhamdia brachyptera* (Cope).
- N *Carpiodes meridionalis* (Günther).
- S *Astyanax mexicanus* (Filippi).
- S *Astyanax æneus* (Günther).
- S *Hemigrammus compressus* Meek.
- N *Dorosoma anale* Meek.
- N *Dorosoma exile* Jordan & Gilbert.
- N *Signalosa mexicana* (Günther).
- T *Cynodonichthys tenuis* Meek.
- T *Pseudoxiphophorus bimaculatus* (Heckel).
- T *Gambusia bonita* Meek.
- T *Paragambusia nicaraguensis* (Günther).
- T *Belonesox belizanus* Kner.
- T *Platyæcilus maculatus* Günther.
- T *Heterandria lutzi* Meek.
- T *Pæcilia sphenops* Cuvier & Valenciennes.
- T *Xiphophorus helleri* Heckel.
- Me *Tylosurus marinus* (Walbaum).
- Me *Menidia lisa* Meek.
- T *Agonostomus monticola* (Bancroft).
- Me *Centropomus mexicanus* Bocourt.
- Me *Pomadasys starri* Meek.
- Me *Pomadasys templei* Meek.
- S *Cichlasoma salvini* (Günther).

- S *Cichlasoma hedricki* Meek.
S *Cichlasoma parma* (Günther).
S *Cichlasoma eigenmanni* Meek.
S *Cichlasoma melanurum* (Günther).
S *Cichlasoma nebulifer* (Günther).
S *Thorichthys helleri* (Steindachner).
S *Thorichthys ellioti* Meek.
T *Philypnus dormitor* (Lacépède).
T *Dormitator maculatus* (Bloch).
T *Chonophorus taiasicus* (Lichtenstein).
Me *Achirus fasciatus* (Lacépède).

Only four out of the total of thirty-seven species are northern, while thirteen are distinctly tropical, of which the genera *Cichlasoma* and *Thorichthys* are largely middle American.

The list may be contrasted with the list of the combined Geronimo and Verde, directly across the headwaters of the Papaloapam and emptying into the Pacific. They were fished near tide water and at an elevation of nearly 5000 feet.

- S *Astyanax æneus* (Günther).
T *Fundulus oxacæ* Meek.
T *Gambusia fasciata* Meek.
T *Anableps dovii* Gill.
T *Heterandria lutzi* Meek.
T *Pacilia sphenops* Cuvier & Valenciennes.
Me *Mugil cephalus* Linnæus.
S *Cichlasoma evermanni* Meek.
T *Philypnus dormitor* (Lacépède.).

Of these, but two are South American, the rest are transitional.

The tropical element has reached farther north on the Atlantic side than on the Pacific, or in any cross section of the country there are more South American elements in the former than in the latter. None of the South American types have reached the plateau of Mexico. They skirt along the coastal plain on both slopes to an elevation of perhaps 2000 feet and in the Rio Grande basin to an elevation of even 3000 feet.

IV. THE MEXICAN REGION.

North of the Rio Balsas, and therefore north of the transition zone is the Rio Grande de Santiago. It is the largest river of the Pacific slope within the tropics or between the Rio Colorado and Tierra del Fuego. It is also by far the richest in species, the Rio Balsas coming next in size and but little further south containing but 12 species as compared with the 48 of the Rio Grande de Santiago. Many of the species of this region (*Chirostoma*) are indirect derivatives from the sea. The only fish in this, the largest Pacific slope river, that suggests South America, is *Cichlasoma beani*, and this occurs only near the coast. Its contact with North America is shown by such genera as *Lampetra*, *Ameiurus*, *Moxostoma*, *Algansea*, *Notropis* and *Hybopsis*.

This basin above the falls separating the coastal section from the Mexican plateau, together with the Valley of Mexico and the headwaters of the San Juan, a tributary of the Panuco, which rises in the Mexican plateau, harbors a fauna that is distinct from both the fauna of North America and that of South America or even southern Mexico. Of this Meek says: "From the area which includes the valley of Mexico, the headwaters of the San Juan del Rio and the Lerma basin, there are at present fifty-four species of fishes known (inclusive of coastal plain species), only two of which, *Moxostoma austrinum* Bean and *Aztecula vittata* (Girard) [to these should be added *Cichlasoma beani*] have been taken in any other river basin. These fifty-four species belong to twenty-one genera, eight of which are peculiar to this region." Three of the other genera are confined to the neighborhood and have probably emigrated from it, six are northern genera, of which only one extends farther south than this area. "The Lerma river system is far from being thoroughly explored, but apparently its fishes are quite as distinct and characteristic as if the fauna were insular."

The relation of each species in the following list to the northern (N), southern (S), or Marine (Me), faunas, whether peculiarly Mexican (M) or belonging to the coastal plain (C), is indicated by the respective symbols.

N *Lampetra spadicea* Bean.

N *Ameiurus dugesi* Bean.

N *Moxostoma austrinum* Bean.

N *Xystrosus popoche* Jordan & Snyder.

N *Algansea tincella* (Cuvier & Valenciennes).

N *Algansea dugesi* Bean.

- N *Algansea rubescens* Meek.
N *Algansea lacustris* Steindachner.
N *Falcula chapalæ* Jordan & Snyder.
N *Aztecula lermæ* Jordan & Snyder.
N *Notropis calientis* Jordan & Snyder.
N *Hybopsis altus* (Jordan).
M *Zoogoneticus cuitzeænsis* (B. A. Bean).
M *Zoogoneticus dugesi* (Bean).
M *Zoogoneticus robustus* (Bean).
M *Zoogoneticus maculatus* Regan.
M *Zoogoneticus diazi* Meek.
M *Characodon multiradiatus* Meek.
M *Characodon eiseni* Rutter.
M *Characodon variatus* Bean.
M *Characodon lateralis* Günther.
M *Chapalichthys encaustus* (Jordan & Snyder).
T *Gambusia infans* Woolman.
M *Goodea luitpoldi* (Steindachner).
M *Goodea atripinnis* Jordan.
M *Skiffia multipunctata* (Pellegrin).
M *Skiffia lermæ* Meek.
M *Skiffia variegata* Meek.
M *Skiffia bilineata* (Bean).
T *Pæcilia occidentalis* (Baird & Girard).
M *Chirostoma jordani* Woolman.
M *Chirostoma arge* (Jordan & Snyder).
M *Chirostoma bartoni* Jordan & Evermann.
M *Chirostoma attenuatum* Meek.
M *Chirostoma labarcæ* Meek.
M *Chirostoma patzcuaro* Meek.
M *Chirostoma zirahuen* Meek.
M *Chirostoma humboldtianum* (Cuvier & Valenciennes).
M *Chirostoma chapalæ* Jordan & Snyder.
M *Chirostoma grandocule* Steindachner.
M *Chirostoma promelas* Jordan & Snyder.
M *Chirostoma sphyrcæna* Boulenger.
M *Chirostoma lucius* Jordan & Snyder.

M *Chirostoma lermæ* Boulenger.

M *Chirostoma ocotlanæ* Jordan & Snyder.

M *Chirostoma estor* Jordan.

CT *Agonostomus monticola* (Bancroft).

CS *Cichlasoma beani* (Jordan).

It is evident from a glance at the letters showing the relationship of these species that the Mexican fauna has not been influenced by the South American fauna. Nor has it influenced in any way the South American fauna.

V. THE ANDEAN REGION.

The Andean Region includes the high Andes on both slopes from Venezuela and Colombia to Chili.

It is poor in species at any given point, but some of the genera have a large number of local adaptations or species. This region is distinctly marked off into three provinces.

1. The Northern includes the high lands of northern Peru, Ecuador, Colombia and Venezuela. This is the richest in species and distinguished by the genera *Arges*, *Cyclopium*, *Prenadilla* and the high development of *Chaetostomus*. Its fauna is largely an ancient derivative from the low-land fresh-water fauna of Archiguiana.

2. The Titicacan, including the basin of Titicaca and neighboring streams, and possibly the land-locked basins of Bolivia, concerning which nothing is known, is distinguished by the genus *Orestias* and the absence of the genera distinguishing the Northern province. Its fauna is largely an ancient derivative from the ocean.

3. The Southern is the poorest in species, characterized by the absence of everything but a few species of *Pygidium*, a genus which extends the entire length of the Andean Region.

Concerning the physical features of the Titicacan province Agassiz says (Bull. Mus. Comp. Zool. III, No. 11, 1875):

"In fact, the geography of the whole of the west coast of the Andes to the north of Chili seems to point to a former condition of things such as we now find on the west coast of Chili. The plains to the southward of Santiago, bounded by the coast range to the westward, and the Andes to the east, gradually pass to the condition of the coast now prevailing at Concepcion Bay, and south of it — the coast range forming the archipelago, the Andes forming the coast range, and the plains of the more

northern regions becoming changed to bays; the immense basins succeeding each other towards the north which form the so-called Desert of Atacama, the nitrate-beds, the llanos of the coast, the pampas of Peru, through which the rivers flowing to the west have cut deep valleys with more or less marked terraces, showing the different periods of ascent in the elevation of the continent. These plains are everywhere found either between a coast range and the base of the eastern talus of the Andes, or extending from the summit of the shore terrace, if we may so call it, generally at a height of from 1200 to 3000 feet, sloping to the second terrace, with its base at an average height of from 6000-7000 feet, and then followed by a second and third more or less indistinct terrace until we reach the main elevated plateau or basin which lies between the eastern and western slope of the Andes. All these basins show more or less distinctly the trace of their former marine origin, so that, if we are to judge from the presence of strictly marine forms, the successive terraces developed on a magnificent scale on the west coast of the Andes, with the interlying basins, we have a fair presumption that the elevation of the Andes to their present height has taken place at a comparatively recent date, and during their upheaval the present nitrate district and saline deposits were left as large lagoons during a considerable period, to judge from the great thickness of the deposits found within their basins, all denoting the presence of a comparatively quiet inland sea.

"Lake Titicaca itself must have, within a comparatively very recent geological period, formed quite an inland sea. The terraces of its former shores are everywhere most distinctly to be traced, showing that its water-level must have had an elevation of 300 or 400 feet at least higher than its present level. This alone would send its shores far to the north in the direction of Pucara, forming a narrow arm reaching up to S. Rosa. Lake Arapa is probably only an outlier of the ancient lake, as well as several of the small lakes, now at a considerable distance from the west shore. The immense plain of Cabanillas, extending north beyond Lampa to Juliaca, only 100 or 120 feet above the lake at its highest point, was one sheet of water. The terraces of the former shores are still very distinctly seen. The eastern shores did not probably differ greatly from the present outline, though the peninsula of Achacache was probably an island. The bay of Puno must have been connected with the plains of Llave, and those back of Juli; while from the lower lake, back of Aygache,

the lake formed huge inlets or deep bays, now represented only by the nearly dry river-beds flowing into the lake at Aygache, Corilla and Guajui. The sluggish Desaguadero must have been a strait of considerable width, with large islands; and this long lake, connecting Lake Titicaca with Lake Aullagas, must have equalled in extent the upper lake, the upper lake, at that time, extending across the Isthmus of Yunguyo, leaving the Peninsula of Copacabana, as a large island, connected with the lower lake by a broad pass between the hills to the west of Copacabana, and those to the west of Yunguyo. The plains, now laid bare at the northern and western shores of Lake Titicaca, give us an excellent idea of the appearance the whole basin of the lake would present if entirely dry. The number of lakes and basins, great and small, which formerly covered the elevated plateau of the Andes, must have been very great; but we now find only here and there a small sheet of water. The former lakes are only represented by the more or less extensive pampas, forming basins at great altitudes, showing plainly that the whole of this district is receiving a much smaller waterfall than in former times, but probably not within historic times, if we take into consideration the position of some of the most ancient ruins of Bolivia (at Tiahuanaco), which are only about 75 feet above the present level of the lake."¹

The area to which Lake Titicaca belongs probably remained separate from Ecuador until long after the latter was colonized from Archiguiana, and the Brazilian fauna did not gain access to the Titicacan region until after the elevation of the lake had become too great for most of the Brazilian types of fishes.

I give below a list of the species of the Northern and Titicacan provinces with the localities from which they are recorded. The Northern province is characterized by several genera, some of them undoubtedly derivatives of the neighboring lowlands marked “/” and by others on the western slope derived from the sea marked “Me.” *Rhamdia* and *Pygidium* have a wide distribution. The Titicacan province is characterized by the extravagant genus *Orestias*, which has developed from a *Fundulus*-like species received when the lake was still an arm of the sea.²

¹ See also page 372.

² The crustacean fauna is even more evidently of marine origin. The genus *Orchestia*, with its seven Titicacan species, is still preëminently a marine genus.

1. *Northern.*

/ *Rhamdia pentlandi* Cuvier & Valenciennes: Monterico, Tullumayo, Rio Huambo.

Pygidium rivulatum (Cuvier & Valenciennes): Ucayale.

Pygidium pæyanum (Cope): Arequiba, Peru.

Pygidium meridæ (Regan): Merida and Rio Albirregas, near Merida, Venezuela.

Pygidium tænia (Kner): western slopes of Peru.

Pygidium laticeps (Kner): western slopes of Peru.

Pygidium knerii (Steindachner): Canelos and Rio Zamora, Peru.

Pygidium eigenmanni (Boulenger): Cumbaca.

Pygidium dispar Tschudi: eastern slope of Peru at an altitude of 14,000 feet.

Pygidium nigromaculatum (Boulenger): Colombia.

Pygidium taczanowskii (Steindachner): Rio de Huambo; Rio de Tortora.

Pygidium quechuorum (Steindachner): Arequipa, Peru.

/ *Eremophilus mutisii* Humboldt: Bogota.

/ *Chaetostomus*—all (14) species of this genus.

/ *Arges*—all (15) species of this genus (to an elevation of at least 10,700 feet).

/ *Cyclopium*—all (4) species of this genus.

/ *Astroblepus grixalvii* Humboldt: Popayan, Rio Cauca.

/ *Creagrutus*—all species.

Me *Protistius semotilus* Cope:¹ Peruvian Andes at an elevation of 12,000 feet).

Me *Gastropterus archæus* Cope:¹ Arequiba, at an elevation of 7,500 feet.

Me *Oreogobius rosenbergii* Boulenger: Paramba, northwest Ecuador, 3,500 feet.

2. *Titicacan.*

Pygidium rivulatum (Cuvier & Valenciennes).

/ *Ancistrus montana* (Regan): eastern Andes of Bolivia.

/ *Ancistrus triformis* (Cuvier & Valenciennes): eastern Andes of Peru and Bolivia.

Orestias—all (11) species of this genus.

From the Southern Province there are known only a very few species of *Pygidium*.

¹ These two genera occur in the latitude of Titicaca, south of the other species. I am not sure that they do not belong to the Titicacan province.

VI. THE BRAZILIAN REGION.

The Brazilian region is divisible into several conspicuously marked provinces; the Central American, including the area from Veragua to the Isthmus of Tehuantepec; the Pacific, including the Pacific slope from Panama to Peru; the Amazonian, including all the lowlands drained by the Amazons; the southeastern, including the streams from Cape San Roque to Santos and the Trinidad Province. Less marked provinces are the La Platan, the Guianan and the Magdalenan, the latter including the Chagres. All of these provinces are distinguished from the Amazonian chiefly by negative characters. The number of peculiar genera varies greatly in the different provinces.

The question of the character of the different provinces is largely a question of what Amazonian types are absent. We shall take up these provinces in detail emphasizing the Central American, Pacific and Magdalenan, as these are of chief interest in discussing later the origin of the Pacific slope fauna, and the East Brazilian and Guianan, because these are the ones principally concerned in the Archiplata-Archhelenis theory.

Manaos is the centre of the great Brazilian region and the variety of the fauna of any province, other things being equal, varies inversely with its distance from Manaos. The Magdalena and the San Francisco at opposite sides of Manaos have essentially the same types of fishes.

1. *The Central American Province.*

This province extends from the Isthmus of Darien to the Isthmus of Tehuantepec.

The most comprehensive account of the Central American province has been given by Günther (An Account of the Fishes of the States of Central America, Trans. Zool. Soc. VI, 1866). Recently Miller has made a detailed study of the Motagua basin. This province will amply repay further study.¹ Günther has shown that this province is distinguished from the South American by the absence of most South American families. A few *Pimelodinæ* of the Nematognathi and a few forms of the Tetragonopterinae and of the Characinae are all there is of the one thousand species of the Ostariophysia found in the Brazilian region. The genera *Cichlasoma* and *Æquidens* are dominant in all the streams.

¹The proof of this had been read before Regan's *Pisces of the Biol. Cent. Amer.* appeared.

Günther has shown that the short and separated water courses are for the most part inhabited by local adaptations or species peculiar to each water system, or two or three of the neighboring systems. For instance, all but two or three of the inhabitants of Lake Peten are peculiar to this small lake.

For this reason he has been able to divide this province into the following subprovinces :

A. Fresh waters north of the Lakes of Managua and Nicaragua, emptying into the Pacific. From this subdivision he recorded 22 species, nearly all of them confined to this region. Only 4 of these species extend north as far as the Isthmus of Tehuantepec. Eight are South American, one, *Lepisosteus*, is northern, nine are transitional or middle American and the rest are Marine.

B. The fresh waters north of the Lakes of Managua and Nicaragua, emptying into the Atlantic. From this subregion he recorded 28 species nearly all of which are peculiar. Eighteen are South American in their relationships. Only four species, *Pimelodus salvini*, *Belonesox belizanus*, *Xiphophorus helleri* and *Ameiurus meridionalis* (from the Usumacinta) are found north of the province; only the last is a northern intrusive. The Rio Motagua contains no North American elements. This subprovince also contains *Gymnotus carapo* and *Symbranchus marmoratus*, the South American species having the farthest range northward.

C. Lake Peten with 14 species, of which all but two were supposed to be peculiar.

D. Lake Managua with 6 species.

E. Lake Nicaragua with 9 species.

F. The fresh waters south of the Lakes of Managua and Nicaragua to the Isthmus of Darien. (The region about Panama is unmistakably South American, as distinct from Central American.)

2. Pacific Province.

The Pacific province includes all the fresh waters emptying into the Pacific from Panama to the southern boundary of Peru, except the headwaters above an elevation of about 3000 feet. It is a narrow strip, nowhere exceeding 200 kilometers in width, and in places less than 50 kilometers wide. North of 5° of south latitude it is abundantly supplied with rivers. South of this point the rivers become smaller and of less importance. The rivers are the Mamoni and Chepo in Panama, Rio San Juan

and Rio Patia Mira in Colombia, the Esmeralda, Daule, Guayas and Tumbey in Ecuador, and the Chia, Jequetepec, Santa, Rimac and others in Peru. None of those in Colombia have been examined, and but few of those in Peru.

The headwaters of these rivers are all near the headwaters of Atlantic slope streams. In northern Ecuador and in Peru they are separated by a high ridge. Of special interest are the San Juan and Patia. In northern Peru there are four main chains of the Cordilleras, besides the coast range. The valleys between these are occupied by large rivers, the Ucayale, Huallaga and Marañon, all ultimately draining into the Amazon. In Ecuador there are two very high chains with frequent cross-ridges dividing the longitudinal trough into parks or highland basins, some drained to the east and some to the west.

In Colombia there are again four chains. The eastern one divides towards the north, one branch sweeping around to the east toward Caracas and Trinidad, another branch extending to the coast west of Lake Maracaibo. Between this and the central chain flows the Magdalena which occupies much the same position in regard to the Cordilleras that the Ucayale or Huallaga occupies, but empties into the Caribbean Sea. Between the central and western Cordilleras flows the Cauca, a large tributary of the Magdalena. South of the Cauca the Rio Patia has cut through the western Cordilleras, its headwaters coming from the same trough in which the Cauca flows.

Of still higher interest is the trough between the western Cordillera and the coast or border Cordillera.

Sievers, p. 478, states that the west Cordillera of Ecuador is younger than the central Cordillera, and the coast range still younger. Its height varies from 800–1800 m. A longitudinal valley separates the coast range from the western Cordillera. In this flows the Atrato towards the north, emptying into the gulf of Darien and the San Juan towards the south, emptying into the Pacific Ocean. The water-shed separating the two scarcely reaches a height of 100 m. above sea-level, the distance of the height of land above their headwaters is naturally much less than this.¹ I shall return to these rivers again.

The fauna of this province, so far as known, is very poor. In con-

¹ A gentleman, for several years a missionary in Colombia, has informed me that the Indians of the Atrato have a legendary belief in a former interoceanic connection through the Atrato valley.

sidering it two things may be borne in mind: 1, that the province, while very long, is very narrow and contains no large river system, which is so necessary to develop or harbor a diverse fauna. The sources of the Paute, a tributary of the Marañon are only 60 km. from the bay of Guayaquil. In North America the large Colorado, Sacramento or Columbia basins of the Pacific slope contain fewer species of fishes than the unknown Beanblossom creek of the Mississippi basin: 2, that no river has been thoroughly explored and some of the principal ones, the San Juan and Patia for instance, not at all.

With very few exceptions, the species of this province belong to genera with a very wide distribution; on the Atlantic slope, all but one of these genera reach as far north as the Magdalena or Panama. Few of the species would have occasioned surprise if they had been discovered at Manaos. There are remarkably few peculiar genera, which indicates a comparatively recent separation from the Atlantic slope fauna. The species recorded from this province are listed below and marked "*" for species peculiar, "**" genus peculiar, "/" species found also in the Chagres or Magdalena, "Me" marine. Most of the species are recorded from Ecuador, few are found in Peru, and Colombia has not been explored.

/ *Rhamdia cinerascens* (Günther): Rio Daule; Rio Peripa; Guayaquil and Esmeraldas; Chagres.

/ *Rhamdia wagneri* (Günther): Atlantic and Pacific slope of Panama; Mamoni near Chepo.

/ *Pimelodus clarias* (Bloch): Rio Bayano—eastern slope to Buenos Aires.

/ *Pimelodella modesta* (Günther): Eastern Panama; Esmeraldas.

* *Pimelodella elongata* (Günther).

* *Pimelodella grisea* Regan: Durango; Sapayo and Vaqueria Rivers, in northwest Ecuador.

* *Pimelodella yuncensis* Steindachner: Pacasmayo.

** *Cetopsogiton occidentalis* (Steindachner): Guayaquil.

Species of *Pygidium*, *Arges*, *Cyclopium* and *Chætostomus* considered under the Andean Region may descend into this province.

* *Pygidium punctulatum* (Cuvier & Valenciennes): Callao.

* *Pygidium pardus* (Cope): Jequitepeque; Callao Bay.

* *Plecostomus spinosissimus* Steindachner: Guayaquil; Rio Vinces; Rio Daule.

* *Plecostomus festæ* Boulenger: Rio Vinces; Rio Peripa.

- * *Hemiancistrus annectens* (Regan): St. Javier and Rio Durango, west Ecuador.
- * *Hemiancistrus aspidolepis* (Günther): Pacific slope of Panama.
- * *Chaetostomus fischeri* Steindachner: Rio Mamoni near Chepo.
- * *Chaetostomus dermorhynchus* Boulenger: Rio Zamora; Rio Santiago; Rio Peripa; Rio Vinces.
- * *Chaetostomus microps* Günther: Western slope of Ecuador.
- * *Loricaria jubata* Boulenger: St. Javier 60 feet; Rio Durango 350 feet.
- * *Loricaria variegata* Steindachner: Mamoni.
- | *Loricaria uracantha* Kner & Steindachner: both slopes of Panama.
- | *Sturisoma panamensis* (Eigenmann & Eigenmann): Rio Magdalena; Pacific slope of Panama.
- * *Sturisoma frenata* Boulenger: St. Javier 60 feet; Salidero 350 feet; Rio Durango 350 feet.
- | *Hoplias microlepis* (Günther): Rio Chagres; Rio Daule; Rio Vinces; Guayaquil.
- ** *Lebiasina bimaculata* Cuvier & Valenciennes: Callao; Rio Vinas; Lima; Remac; Eten.
- * *Curimatus troschelii* Günther: Guayaquil; Rio Vinces.
- | *Curimatus magdalenæ* Steindachner: Magdalena; Mamoni.
- * *Curimatus bouleengeri* Eigenmann: Rio Vinces.
- * *Prochilodus humeralis* Günther: Rio Peripa, western Ecuador.
- * *Prochilodus caudofasciatus* Starks: Perene.
- ** *Saccodon wagneri* Kner & Steindachner: Ecuador.
- ** *Saccodon craniocephalum* Thominot: Rio Guayaquil.
- * *Leporinus leschenaulti* Cuvier & Valenciennes: Guayaquil.
- * *Piabucina astrigata* Regan.
- ** *Pseudochalceus lineatus* Kner: western slope of the Andes of Ecuador.
- * *Astyanax festæ* (Boulenger): Rio Vinces and Mirador, Ecuador.
- | *Astyanax rutilus* (Jenyns): western Ecuador: Rio de la Plata to Mexico.
- * *Astyanax simus* (Boulenger): western Ecuador.
- Astyanax peruanus* (Müller & Troschel): Rio Remac; Pacasmayo; Lake Amatitlan, Rio Eten and Payta, Peru.
- * *Hemibrycon polyodon* (Günther): Guayaquil.
- * *Brycon alburnus* Günther: Rio Peripa and Rio Vinces, western Ecuador.
- | *Brycon dentex* Günther: Esmeraldas and Rio Peripa to Lake Nicaragua and Rio Usumacinta.

/ *Brycon atrocaudatus* Kner: Magdalena; Paramba, western Ecuador, Payta and Eten, Peru.

? *Creagrutus peruanus* Steindachner: Monterico and Huambo, Peru.

/ *Creagrutus mülleri* Günther: Cauca; Canelos; Andes of western Ecuador.

* *Gasteropelecus maculatus* Steindachner: Mamoni.

/ *Luciocharax insculptus* Steindachner: Mamoni; Magdalena.

/ *Eigenmannia humboldtii* (Steindachner): Mamoni; Magdalena.

/ *Gymnotus æquilabiatus* Humboldt: Guayaquil; Magdalena.

/ *Symbranchus marmoratus* Bloch: Panama; entire eastern slope.

Me *Stolephorus poeyi* (Kner & Steindachner): Rio Bayano.

Me *Pristigaster effulgens* Regan: Rio Vaqueria.

Fundulus guatemalensis Günther: western Ecuador to Amatitlan and Guacalate.

* *Aplocheilus peruanus* Regan: Perim.

* *Pæcilia festæ* Boulenger: Hot Springs, S. Vicenta, Santa Elena, Ecuador.

Me *Tylosurus fluviatilis* Regan: Western Ecuador.

* Me *Centropomus atridorsalis* Regan: Rio Vagueria, near la Tola, N. W. Ecuador.

* *Æquidens sapayensis* Regan: Rio Sapayo, Ecuador.

* *Æquidens rivulata* (Günther): Rio Sapayo; Rio Peripa; Rio Vincas.

/ *Cichlasoma godmanii* Günther: west slope of Panama; Rio Cahabon, Atlantic slope.

* *Cichlasoma festæ* Boulenger: Rio Durango, Ecuador.

Me * *Awaous güntneri* Regan: western Ecuador.

Me * *Awaous transandeanus* Günther: western Ecuador.

Me * *Goboides peruanus* Steindachner.

Me * *Chasmodes maculipinna* Regan: Rio Durango.

Number of species, 65; number peculiar, 42; on Atlantic slope, 18 of which in Amazon, 3.

These are for the most part lowland species belonging to lowland genera, *i. e.*, not such as are found in mountain streams or that are likely to have reached the Pacific slope by crossing the high Andes. *Pygidium* and *Chaetostomus* are exceptions to this. If all of the purely freshwater species could be transferred to Manaos or Tabatinga there are very few that would occasion surprise if taken in the collector's net.

3. Magdalena Province.

The fauna of the Rio Magdalena, as far as known, is of peculiar interest, in connection with the fauna of the Pacific Province. The Magdalena basin is Y-shaped. The right (thick) arm and stem form the Rio Magdalena proper, draining the area between the eastern and central Andes of southern Colombia. The left arm of the Y is the Cauca, which drains the area between the central and the western Andes of Colombia. The central Andes appear to stop at the junction of the arms of the Y.

The Magdalena has an elevation of 1600 m. at San Augustin, 1000 m. at Timana and 400 m. at Neiva. There are rapids at the 5th degree of north latitude about Pescaderias. In its lower course it is a much-branched and divided stream. Its length is about 1350 km. and it drains 300,000 square kilometers. The Cauca at Popayan has an elevation of 1740 m. It is marked with rapids at Quilichao 1070 m., and again, below Cartago, 900 m., and between Antioquia and Caceres.

Nearly all that is known of the fauna of this river has been contributed by Steindachner in three papers, in which the following fresh-water species are enumerated (exclusive of mountain forms).

Species *, and genus **, peculiar to the Magdalena; species /, and genus //, peculiar to Magdalena, Panama and western slopes of Ecuador. A, also found in the Amazon.

* *Potamotrygon magdalenæ* Steindachner.

A *Pseudopimelodus zungaro* (Humboldt).

A *Rhamdia sebæ* (Cuvier & Valenciennes).

A *Pimelodus clarias* (Bloch).

* *Pimelodus grosskopfii* Steindachner.

A *Pseudoplatystoma fasciatum* (Linnæus).

A *Sorubim lima* (Bloch & Schneider).

* *Doras longipinnis* Steindachner.

Trachycorystes insignis (Steindachner).

Trachycorystes magdalenæ (Steindachner).

* *Ageneiosus caucanus* Steindachner.

A *Ageneiosus dentatus* Kner.

? *Pygidium*, probably several species in upper reaches of the rivers.

A *Hoplosternum thoracatum* Cuvier & Valenciennes.

A *Plecostomus emarginatus* Cuvier & Valenciennes.

* *Panaque cochliodon* (Steindachner).

- * *Pterygoplichthys undecimalis* (Steindachner).
- * *Loricaria filamentosa* Steindachner.
- * *Loricaria magdalenæ* Steindachner.
- | *Sturisoma panamense* (Eigenmann & Eigenmann).
- A *Hoplias malabaricus* (Bloch).
- | *Curimatus magdalenæ* Steindachner.
- * *Curimatus mivartii* Steindachner.
- A *Prochilodus rubrotæniatus* Schomburgk.
- * *Prochilodus magdalenæ* Steindachner.
- * *Prochilodus longirostris* Steindachner.
- A *Leporinus eques* Steindachner.
- * *Leporinus muyscarus* Steindachner.
- A *Leporinus obtusidens* (Valenciennes).
- A *Leporinus striatus* Kner.
- A *Leporellus vittatus* (Cuvier & Valenciennes).
- * *Cheirodon insignis* Steindachner.
- A *Astyanax bimaculatus* (Linnæus).
- | *Astyanax rutilus* (Jenyns).
- * *Astyanax caucanus* (Steindachner).
- * *Brycon rubricauda* Steindachner.
- | *Brycon atricaudatus* (Kner).
- * *Othonophanes labiatus* (Steindachner).
- | *Creagrutus mülleri* Günther. (Cauca and Ecuador).
- * *Chalcinus magdalenæ* Steindachner.
- * *Poeboides dayii* Steindachner.
- Cynopotamus magdalenæ* Steindachner. (Magdalena and Paraguay).
- Salminus affinis* Steindachner. (Magdalena and Ecuador).
- ** *Acestrocephalus anomalus* (Steindachner).
- ** *Gilbertolus alatus* (Steindachner).
- || *Luciocharax insculptus* Steindachner.
- A *Hypopomus brevirostris* Steindachner.
- ? | *Eigenmannia humboldtii* (Steindachner).
- | *Gymnotus æquilabiatus* Humboldt.
- A *Synbranchus marmoratus* Bloch.
- * *Rivulus elegans* Steindachner.
- * *Girardinus caucanus* Steindachner.
- Æquidens pulchrum* (Gill). (Rio Chagres to Trinidad.)

* *Cichlasoma kraussii* Steindachner.

* *Geophagus steindachneri* Eigenmann & Hildebrandt.

| *Geophagus crassilabris* Steindachner.

Undoubtedly this is but a small part of the fauna of this basin. As our knowledge stands at present, this basin lacks very largely those Amazonian genera that are also absent from the coastal plain of southeastern Brazil. See later List. Thirty per cent. of its known species are Amazonian.

4. *The Amazon Province.*

East of the Cordilleras, and therefore east of the Magdalena basin, is found the most extensive and intricate fresh water system in the world. It forms a network of rivers practically uninterrupted, extending from the mouth of the Orinoco through the Cassiquiare, Rio Branco, Rio Negro, Rio Madeira, Rio Guaporé, Rio Paraguay, Parana and La Plata to Buenos Aires, through 45° of latitude and from Para to within a few miles of the Pacific coast, through 30° of longitude at the equator.

The connection between the Orinoco and Branco through the Cassiquiare has been definitely known since Humboldt traversed it. The following is from the International Bureau of American Republics, "United States of Brazil," p. 79:

"Another remarkable phenomenon of the Paraguay is the mingling of its principal head waters with those of the affluents of the Amazon. An affluent of the Jauru River is sufficiently near the Guaporé River to be connected with the latter by a canal. The Aguapehy, another tributary of this river, is separated from the Alegre by a narrow isthmus 5 kilometers wide. In the eighteenth century an attempt was made to open up a canal here, and owing to the abundant rains a large canoe of 12 oars succeeded in passing from the one river to the other. One of the governors of the state also endeavored to open up a canal 10 kilometers long in another part of the isthmus, but on account of the small amount of trade it was never completed. This would connect Montevideo and Para by a continental waterway 8300 kilometers long. In the near future it is probable that railways will take the place of the canal. There are many places on the edge of the plateau, farther to the east, where a simple cut of a few meters would connect the tributaries of the Amazon with those of the Paraguay, transforming eastern Brazil into an island. There is a

space of but 100 meters between the Estivado, a small tributary of the Tapajoz, and the Tombador, which empties into the Cuyaba."

Cuyaba on the headwaters of the Paraguay is not more than 200 m. in elevation and the junction of the Cassiquiare with the Orinoco has an elevation of but 280 m. One could therefore traverse the 8300 kilometers by inland water without ever exceeding an elevation of 280 m.

The Amazon itself, where it leaves the Andes, has an elevation of but 180 m.; indeed nearly 60 per cent. of all South America consists of flat lowlands, drained by this system of rivers.

The Amazon draining more than 7,000,000 square kilometers, the La Plata about 3,100,000 and the Orinoco about 1,000,000, these rivers which as far as the fishes are concerned form a single system, drain an area $3\frac{2}{3}$ times as large as the Mississippi basin.

The lowlands through which these main rivers flow are the youngest part of South America. The parts that first arose out of the sea and became populated with fresh-water fishes were probably two land areas. The one embraces the highlands of Guiana and Northern Brazil, the other the highlands of Brazil east of the Araguay and south of the falls of the Tapajos. In Tertiary times the Cordilleras arose out of the ocean on the west. The basins left as open seas between the three land areas later, in late Tertiary, became dry land, in part by elevation and in part by delta formation by the rivers coming from the surrounding land masses. The rivers coming from the Andes became stocked from the surrounding ocean and *later* from one of the older eastern land areas. *The main part of the later colonization very probably did not take place until the Andes had become an effective barrier to the distribution of fresh-water fishes.*

These interior rivers, chiefly the Amazons, colonized from the northeast and southeast became themselves the seat of unparalleled adaptive radiation and centers of distribution, as we shall see.

The Amazons are unequalled in richness and form a province distinct from the Orinoco and Guiana region to the north and the La Plata on the south. The La Plata basin is well distinguished from the Amazonian, but by negative characters only.¹

¹ I insisted on this distinction in 1891. Perugia registered his "disgosto" with this scheme, because the fishes from the La Plata basin were nearly all Amazonian, as I had pointed out.

Neither the Orinoco nor the Paraguay contains any fishes that would cause the slightest surprise if they were found at Manaos or any other part of the Amazon. Every collection made in the Paraguay in recent years has brought to light more types hitherto considered Amazonian and has increased the number of genera and species that the two systems have in common. Very little is yet known of the Orinoco.

The list of Amazonian species is too long to give here. The Amazonian species have therefore been marked A in the general list of the species forming Part III of this report. They number about 700.

5. *The Guiana Province.*

The Guiana Province, including one of the oldest land masses, is drained by the Cachipur, Oyapoc, Cayenne, Mana, Maroni, Surinam, Corentine, Essequibo (Mazaruni, Cuyuni, Rupununi and other tributaries of the Essequibo), Demarara, Berbice, by the Orinoco and its eastern and southern tributaries, the Caroni, Caura, Ventuari and by the Rio Branco, and the northern tributaries of the Amazon east of the Branco.

The feature distinguishing this region is the known or reported connections between neighboring streams. The Cassiquiari connects the Orinoco with the Rio Negro. The Atabapo is said during the rainy season to be connected with the Guaina, and the Rupununi of the Essequibo basin with the Tacutu of the Rio Branco basin. It is said that the Essequibo is also connected with the Rio Trombetas through the Apini and the Oyapoc, Cachipur and Araguay with the tributaries of the Yari which empties into the Amazon.

The lower course of the Essequibo of British Guiana at least is connected with the lower Orinoco by natural canals, so that these form part of the Orinoco-Amazon-La Plata meshwork and contain the same types. The Eastern Guianas (French) have a less varied fauna.

The fauna of this region is of the greatest importance to theoretical chorology, since this is one of the two old land-masses, and since it was by a continuation of this area that South America is supposed to have been connected with Africa.

Our knowledge of the fish fauna of this region is derived from Müller & Troschel's account of the fishes of British Guiana; Bleeker's *Silure de Surinam*; Vaillant's notes on the fishes of French Guiana, and his account of the Berbice and the general work of Cuvier & Valenciennes, Günther, Eigenmann & Eigenmann, Regan and Pellegrin.

Unfortunately little is known of the fauna of the streams of the table land of Guiana, the region where the remnant of the original fauna may be expected to persist. Schomburgk's collections made in these streams were largely lost. He states that it was rich in species (over 30).

André ("A Naturalist in the Guianas," p. 205) says: "In fact the falls of Para [of the Caura] appear to constitute an effective barrier between distinct forms of river life," and that the fauna above the falls is different from that below.

The most promising field for scientific results, if not number of species, seems to me to be offered by the rivers of this region, which should be explored *above* and *below* falls that are impassable barriers for the ascent of fishes.

The rivers of this region, exclusive of the northern tributaries of the Amazon, concerning which not much is known, contain a total of about 298 recorded species. Of these about 60 per cent. are also found in the Amazon; as of these about 16 species are from the Rio Branco basin and not from the other streams and the Rio Branco belongs to the Amazon system, this number must be reduced by 16, which still leaves over 50 per cent. of the fauna identical with that of the Amazon.

LIST OF GUIANA FISHES WITH THEIR KNOWN DISTRIBUTION.

In the following list the letter A indicates that the species has been recorded from the Amazon. L indicates that the species has been recorded from the La Plata, S that the genus is also found in the San Francisco, * that the species is peculiar to the province, ** that the genus is peculiar to the province.

	Rio Branco.	Takutu.	Lake Amucu.	Orinoco.	Barima.	Waini.	Pomeroon.	Essequibo.	Cuyuni.	Mazaruni.	Rupununi Rewa.	Cuyuwini.	Demerara.	Berbice.	Corentine.	Surinam.	Maroni.	Mana.	Cayenne and Mahuey.	Carsevenne.	Lunier.	Carnot.	Cachipour.
* <i>Paratrygon strongylopterus</i> (Schomburgk).	×	×									×												
AL <i>Potamotrygon hystrix</i> (Müller & Henle).	×	×		×							×												
* <i>Potamotrygon d'orbignyi</i> Castelnau.				×																			
A <i>Potamotrygon reticulatus</i> Günther.																×							
L <i>Potamotrygon motoro</i> (Müller & Henle).	×	×																					
A <i>Ellipsurus spinicauda</i> Schomburgk.	×	×																					
* <i>Bunocephalichthys hypsiurus</i> (Kner).	×																						
A <i>Bunocephalus gronovii</i> Bleeker.													×										
A <i>Platystacus cotylephorus</i> Bloch.														×		×							
* <i>P. nematophorus</i> Bleeker.																×							
A <i>P. aspredo</i> (Linnaeus).						×								×		×			×				
* <i>P. sicuephorus</i> (Cuv. & Val.).																1							
* <i>P. filamentosus</i> (Cuv. & Val.).													×						×				
A <i>P. tibicen</i> (Temmink).														×		×							
A <i>Callophysus macropterus</i> (Lichtenstein).				×				×															
A <i>Pinirampus pirinampu</i> (Spix). ³																							
AL <i>Luciopimelodus pati</i> (Val.).	×																						
SA <i>Pseudopimelodus raninus</i> (Cuv. & Val.).				×				×															
AL <i>Ps. zungaru</i> (Humboldt).																			×				
S* <i>Rhamdia laukidi</i> Bleeker. ⁴																							
A <i>Rh. schomburgkii</i> Bleeker. ⁵																							
A <i>Rh. sebæ</i> (Cuv. & Val.). ⁶								×					×	×		×			×				
* <i>Rh. foina</i> Müller & Troschel.		×																					
A <i>Rh. multiradiatus</i> (Kner.).		×						upper	×														
S* <i>Rhamdella notata</i> (Schomburgk).	×																						
AL <i>Heptapterus mustelinus</i> (Val.).																						×	
* <i>Acentronichthys surinamensis</i> (Bleeker).																×							
SAL <i>Pimelodus ornatus</i> Kner.				×												×							
AL <i>Pimelodus clarias</i> (Bloch).				×	×	×	?	×	?	?	?	?	?	?		×			×	×			
A <i>Pimelodus altipinnis</i> (Steind.).																							
A <i>Gœldiella eques</i> (Müller & Troschel). ⁷						?	?	?	?	?	?	?	?	?									
SA <i>Pimelodella cristatus</i> (Müller & Troschel). ⁸		×						×															
A <i>P. wessellii</i> (Steind.).								×															
AL <i>P. gracilis</i> (Valenciennes).				×																		×	
A <i>Platynematichthys punctulatus</i> (Kner).																							
A <i>Phractocephalus hemiliopterus</i> (Bloch & Schnei.). ⁹						?	?	?	?	?	?	?	?	?									
A <i>Brachyplatystoma vaillanti</i> (Cuv. & Val.).				×									×			×			×				
AL <i>Hemisorubim platyrhynchos</i> (Cuv. & Val.).				×																			
SA <i>Pseudoplatystoma fasciatum</i> (Linnaeus).				×				×								×							
A <i>Ps. tigrinum</i> (Cuv. & Val.). ¹⁰						?	?	?	?	?	?	?	?	?									
AL <i>Sorubim lima</i> (Bloch & Schneider).	×			×																			
A <i>Sorubimichthys planiceps</i> (Agassiz).	×			×																			
SA <i>Doras dorsalis</i> Cuv. & Val.	×																		×				
* <i>D. albomaculatus</i> Peters.				×																			
* <i>D. helicophilus</i> Günther.																							
* <i>D. dentatus</i> Kner.																							
AL <i>D. costatus</i> (Linnaeus). ¹¹													×			×							
AL <i>D. armatulus</i> Cuv. & Val.				×																			
A <i>D. cataphractus</i> (Linnaeus).								upper	×							×							
A <i>D. affinis</i> Kner.	×																						
* <i>D. castaneo-ventris</i> Schomb. ¹²																							
SA <i>Oxydoras niger</i> (Val.). ¹³								?	?	?	?	?	?										

¹ French Guiana.² British Guiana.³ Guiana.⁴ Guiana.⁵ Guiana.⁶ British Guiana.⁷ In all rivers of Guiana.⁸ Rio Mahu.⁹ All rivers of Guiana.¹⁰ Rivers of Guiana.¹¹ British Guiana.¹² Rio Pasawiri.¹³ All rivers of British Guiana.

	Rio Branco.	Takutu.	Lake Amucu.	Orinoco.	Barima.	Waini.	Pomeroon.	Essequibo.	Cuyuni.	Mazaruni.	Rupununi Rwa.	Cuyuwini.	Demerara.	Berbice.	Corentine.	Surinam.	Maroni.	Mana.	Cayenne and Mahuey.	Carsevenne.	Unier.	Carnot.	Cachipour.
A <i>Oxydoras carinatus</i> (Linn.).								×								×			×				
AL <i>Trachelyopterus coriaceus</i> Cuv. & Val.																			×				
* <i>Centromochlus oncina</i> (Schomb.). ¹																							
A <i>C. heckelii</i> Philippi.				×																		×	
A <i>C. perugiae</i> Steindachner.																							
A <i>C. aulopygius</i> Kner.				×				×															
S* <i>Trachycorystes glaber</i> (Steind.).													×										
* <i>T. obscurus</i> (Günther).								×															
A <i>T. ceratophysus</i> (Kner.).		×																					
AL <i>T. galeatus</i> (Linnæus).		×	×																×				
* <i>T. robustus</i> (Günther).													×										
SA <i>Pseudauchenipterus nodosus</i> (Bloch). ²													×			×							
A <i>Auchenipterus nuchalis</i> (Spix).																×			×				
* <i>Ageneiosus inermis</i> (Linnæus).																×							
* <i>A. armatus</i> Lacépède.																×							
A <i>A. dentatus</i> Kner.																×							
* <i>A. porphyreus</i> Cope.																×							
A <i>A. dawwalla</i> (Schomburgk).											×					×							
AL <i>A. brevifilis</i> Cuv. & Val.																×							
* <i>A. axillaris</i> Günther.																×							
** <i>Helogenes marmoratus</i> Günther.								×								×							
A <i>Hypophthalmus edentatus</i> Spix.	×												×			×			×				
A <i>Cetopsis cœcutiens</i> (Lichtenstein).				×												×							
S <i>Pygidium tænia</i> (Kner.).																						×	
A <i>Vandellia plazaii</i> Castelnau.				×																			
AL <i>Callichthys callichthys</i> (Linnæus).				×												×			×				
AL <i>Hoplosternum littorale</i> (Hancock).				×									×	×		×			×	×			
A <i>H. thoracatum</i> (Cuv. & Val.). ³	×			×												×		×					
A <i>Corydoras punctatus</i> (Bloch).								×								×			×				
SAL <i>Plecostomus plecostomus</i> (Linnæus). ⁴	×													×		×			×				
A <i>P. verres</i> (Cuv. & Val.).																×			×				
A <i>P. emarginatus</i> (Cuv. & Val.).	×			×				×								×			×				
* <i>Hemiancistrus medians</i> (Kner).																×							
AL <i>Cochliodon cochliodon</i> (Kner).				×																			
* <i>Hemiancistrus schomburgkii</i> (Günther). ⁵		×														×							
* <i>H. megacephalus</i> (Günther).																×							
<i>Pterygoplichthys etentaculatum</i> (Spix).				×																			
SAL <i>P. multiradiatus</i> (Hancock).													×										
L <i>P. barbatus</i> (Cuv. & Val.). ⁶																×		×					
* <i>P. depressus</i> (Günther).																×							
* <i>P. guentheri</i> (Regan). ⁷																×							
L <i>Xenocara gymnorhynchus</i> (Kner).		×																					
A <i>Ancistrus dolichoptera</i> (Kner).		×														×			×				
* <i>A. temminckii</i> (Cuv. & Val.).		×														×			×				
AL <i>A. hoplogenys</i> Günther.								×															
AL <i>A. cirrhosus</i> (Val.).								×															
* <i>Pseudacanthicus serratus</i> (Cuv. & Val.).																×							
* <i>Ps. fordii</i> Günther.																×							
A <i>Acanthicus hystrix</i> Spix.	×																						
<i>Loricaria filamentosa</i> Steind.														×									
SA <i>L. maculata</i> Bloch.				×										×		×							
AL <i>L. typus</i> (Bleeker).																×							

¹ Rio Padawiri.
Müller & Troschel.² British, French and Dutch Guiana.
⁵ British Guiana.³ Curassarrasa.
⁶ British Guiana.⁴ Probably as *H. commersoni*
⁷ British Guiana.

	Rio Branco.	Takutu.	Lake Amucu.	Orinoco.	Barima.	Waini.	Pomeroon.	Essequibo.	Cuyuni.	Mazaruni.	Rupununi Rewa.	Cuyuwini.	Demerara.	Berbice.	Corentine.	Surinam.	Maroni.	Mana.	Cayenne and Mahuey.	Carsevenne.	Lunier Carnot.	Cachipour.
AL <i>Loricaria cataphracta</i> Linnæus.				×												×			×			
* <i>L. brunnea</i> Hancock.													×									
* <i>L. platyura</i> Müller & Troschel.											×											
* <i>Harttia platystoma</i> (Günther).																×						
A <i>Neoplecostomus granosus</i> (Cuv. & Val.).																			×			
SAL <i>Hoplias malabaricus</i> (Bloch). ¹				×	?	?	?	×	?	?	?	?	×						×	×	×	
SAL <i>Hoplerethrinus unitæniatus</i> (Spix).														×				×	×	×	×	
A <i>Erythrinus erythrinus</i> (Bloch & Schneider).																×			×			
* <i>Erythrinus longipinnis</i> Günther.								×								×						
* <i>Pyrrhulina filamentosa</i> Cuv. & Val.																×					×	
* <i>Elopomorphus orinocensis</i> Steind.					×																	
AL <i>Psectrogaster ciliatus</i> (Müller & Troschel).			×																			
SAL <i>Curimatella alburnus</i> (Müller & Troschel).			×	×																		
SA <i>Curimatus spilurus</i> Günther.								×													×	
* <i>C. microcephalus</i> E. & E.																						
A <i>C. knerii</i> Steindachner.	×																					
A <i>C. cyprinoides</i> (Linnæus).								×											×	×		
* <i>C. schomburgkii</i> Günther.													×			×						
* <i>C. essequibensis</i> Günther.								×														
AL <i>Semitapicis latior</i> Spix.																×						
SA <i>Prochilodus rubrotæniatus</i> Schomb.	×							×														
A <i>P. insignis</i> Schomb.	×																					
A <i>P. binotatus</i> Schomb.	×																					
* <i>P. laticeps</i> Steind.					×																	
A <i>P. brama</i> (Cuv. & Val.).					×																	
A <i>Cænotropus labyrinthicus</i> (Kner).	×				×																	
* <i>Chilodus punctatus</i> (Müller & Trosch.). ²			×																		×	
SAL <i>Hemiodus unimaculatus</i> (Bloch).								×													×	
A <i>H. semitæniatus</i> Kner.																						
A <i>H. immaculatus</i> Kner.					×																	
* <i>Anisitsia keppleri</i> (Günther).																						
A <i>A. notatus</i> (Schomburgk).								×								×						
* <i>Nannostomus beckfordii</i> Günther.													×									
SA <i>Anostomus anostomus</i> (Linnæus).								×														
* <i>Anostomus orinocensis</i> (Steind.).					×																	
AL <i>Schizodon fasciatus</i> (Spix.).	×	×									×		×									
SAL <i>Characidium fasciatum</i> Reinhardt.					×																	
AL <i>Leporinus striatus</i> Kner.					×																	
SA <i>L. nigrotæniatus</i> (Schomb.).	×						×	×														
A <i>L. mülleri</i> Steind.					×																	
A <i>L. megalepis</i> Günther.								×													×	
AL <i>L. frederici</i> (Bloch).	×				×		×	×								×		×				
AL <i>L. affinis</i> Günther.					×																	
AL <i>L. hypselonotus</i> Günther.					×																	
AL <i>L. fasciatus</i> (Bloch).					×											×						
* <i>L. margaritaceus</i> Günther.											×											
A <i>L. maculatus</i> Müll. & Trosch. ⁴																						
A <i>Piabucina unitæniatus</i> Günther.																						
** <i>Scissor macrocephalus</i> Günther.																×						
SA <i>Hemigrammus unilineatus</i> Gill.					×																	
* <i>H. riddlei</i> Meek.					×																	
* <i>H. micropterus</i> Meek.					×																	

¹ All rivers of Guiana. ² Savanna swamps of British Guiana. ³ British Guiana. ⁴ Awaricuru. ⁵ British Guiana.

	Rio Branco.	Takutu.	Lake Amucu.	Orinoco.	Barima.	Waini.	Pomeroon.	Essequibo.	Cuyuni.	Mazaruni.	Rupununi Kewa.	Cuyuwini.	Demerara.	Berbice.	Corentine.	Surinam.	Maroni.	Mana.	Cayenne and Mahuey.	Carsevenne.	Lunier.	Carnot.	Cachipour.
A <i>Hemigrammus belotti</i> (Steindachner).				X																			
L <i>Ctenobrycon hauxwellianus</i> (Cope).				X																			
AL <i>Tetragonopterus argenteus</i> Cuvier.			X	X																			
AL <i>T. chalceus</i> Agassiz.				X				X								X				X			
* <i>Poptella longipinnis</i> (Popta).													1										
A <i>Fowlerina orbicularis</i> (Cuv. & Val.).								X								X						X	
* <i>Astyanax polylepis</i> (Günther).								2															
S* <i>A. spilurus</i> (Cuv. & Val.).																X							
AL <i>A. abramis</i> (Jenyns).				X																			
AL <i>A. bimaculatus</i> (Linnæus).				X				X		X			X			X			X				
* <i>A. wappi</i> (Cuv. & Val.).								3															
AL <i>A. fasciatus</i> (Jenyns). ⁴						?	?															X	
AL <i>Cretochanes melanurus</i> (Bloch).								X			X										X	X	
* <i>C. affinis</i> Günther.								6													X	X	
* <i>Mænkhausia grandisquamis</i> (Müller & Troschel)																X						X	
AL <i>M. lepidurus</i> (Kner).																						X	
* <i>M. oligolepis</i> (Günther).								5														X	
* <i>M. chrysargyreus</i> Günther.								X														X	
* <i>M. ovalis</i> Günther.								2														X	
** <i>Chalceus macrolepidotus</i> Cuvier.								X	X														
S* <i>Brycon longiceps</i> Steind.				X																			
* <i>B. schomburgkii</i> Müller & Troschel.								X															
* <i>B. pesu</i> Müller & Troschel.								X	X														
* <i>B. falcatus</i> Müller & Troschel.	?	?				?	?	X	?	?	?	?				X							
* <i>B. lucidus</i> (Kner).	X																						
LA <i>Thoracocharax stellatus</i> (Kner).				X																			
A <i>Gasteropelecus sternicla</i> Linnæus.								X								X							
SAL <i>Chalcinus angulatus</i> Spix.				X				X															
A <i>C. güntheri</i> Garman.																							
A <i>C. elongatus</i> Günther.				X																			
** <i>Agoniatès halecinus</i> Müller & Troschel.									X														
A <i>Piabucus dentatus</i> (Kœlreuter).			X			?	?																
A <i>Crenuchus spilurus</i> Günther.								X															
A <i>Pygopristis denticulatus</i> (Cuvier).		X						X			X												
S* <i>Pygocentrus niger</i> (Schomburgk). ⁸																							
AL <i>P. piraya</i> (Cuvier).	X														X								
A <i>P. scapularis</i> (Günther).				X				9															
AL <i>P. nattereri</i> (Kner).				?																			
AL <i>Serrasalmo gymnogonys</i> Günther.				X																			
SAL <i>Serrasalmo marginatus</i> Val.				X																			
AL <i>S. spilopleura</i> Kner.								X			X												
* <i>S. rhombeus</i> (Linnæus).		X						X			X		X			X							
A <i>Catoprion mento</i> (Cuvier).			X																				
A <i>Acnodon oligocanthus</i> (Müller & Troschel).													X			X							
A <i>Piaractus macropomus</i> (Cuvier).					X																		
A <i>Metynnis hypsauchen</i> (Müller & Troschel). ¹⁰								X															
AL <i>M. maculatus</i> (Kner).																	X				X		
SA <i>Myleus setiger</i> (Müller & Troschel).								X ¹¹											X				
* <i>M. schomburgkii</i> (Jardine). ¹²		X				X					X												
A <i>M. torquatus</i> (Kner).	X																						
* <i>M. ellipticus</i> (Günther).								X															
* <i>M. knerii</i> (Steindachner).																	X						

¹ Dutch Guiana.² British Guiana.³ British Guiana.⁴ Ditches and swamps near coast.⁵ British Guiana.⁶ British Guiana.⁷ Savanna swamps.⁸ In upper courses of streams of British Guiana.⁹ British Guiana.¹⁰ Lake Tapacumea.¹¹ Below the cascades.¹² Zuraima and Savanna swamps.

	Rio Branco.	Takutu.	Lake Amucu.	Orinoco.	Barima.	Waini.	Pomeroon.	Essequibo.	Cuyuni.	Mazaruni.	Rupununi Rewa.	Cuyuwini.	Demerara.	Berbice.	Corentine.	Surinam.	Maroni.	Mana.	Cayenne and Mahuey.	Carsevenne.	Lunier.	Carnot.	Cachipour.
A <i>Myleus discoideus</i> (Kner).	×																						
A <i>M. rhomboidalis</i> (Cuv.). ¹					?	?	?	×	?	?	?	?	?	?		×	×						
* <i>M. rubripinnis</i> (Müller & Troschel).								×															
AL <i>M. asterias</i> (Müller & Troschel).								×	×														
AL <i>Mylossoma aureus</i> (Spix).	×			×																			
AL <i>Characinus gibbosus</i> (Gronow).								lower	×							×	×						
SA <i>Ræboides affinis</i> (Günther).				×																			
<i>R. microlepis</i> (Reinhard).				×																			
A <i>Cynopotamus humeralis</i> Val.				×																			
A <i>Exodon paradoxus</i> Müller & Troschel.	×							×		×													
AL <i>Salminus hilarii</i> Cuv. & Val.				×																			
SA <i>Acestrorhynchus falcirostris</i> (Cuv.).													×										
A <i>A. microlepis</i> (Schomburgk). ²	×	×					×	upper	×		×												
AL <i>A. falcatus</i> (Bloch).							×	×													×		
A <i>Hydrocynus cuvieri</i> (Agassiz).		×		×				×		×													
A <i>H. ocellatus</i> (Schomburgk).	×							×															
AL <i>Rhaphiodon vulpinus</i> Spix.				×																			
AL <i>Hydrolycus scomberoides</i> (Cuv.).				×				×															
SAL <i>Sternarchus albifrons</i> Linnæus.				×												×							
* <i>Sternarchogiton sachsii</i> (Peters).				×																			
* <i>Sternarchorhynchus oxyrhynchus</i> (M. & T.).								×															
A <i>Rhamphichthys rostratus</i> (Linnæus).								3								×			×				
AL <i>R. marmoratus</i> Castelnau.				×												×							
* <i>Hypopomus artedi</i> Kaup. ⁴																	4	×					
S* <i>Eigenmannia microps</i> (Boulenger).																							
AL <i>E. virescens</i> (Val.).			×	×												×							
SAL <i>Giton fasciatus</i> (Pallas).			×	×				×						×		×							
SAL <i>Gymnotus carapo</i> Linnæus.	×			×				×						×		×	×						
A <i>Electrophorus electricus</i> (Linnæus). ⁵	?	?	?	×	?	?	?	?	?	?	?	?	?						×				
AL <i>Synbranchus marmoratus</i> Bloch.				×				×						×		×			×				
A <i>Stolephorus spinifer</i> (Cuv. & Val.).														×									
A <i>S. clupeoides</i> (Swainson).																×							
A <i>Pterengraulis atherinoides</i> (Linnæus). ⁶																							
A <i>Lycengraulis grossidens</i> (Cuvier). ⁶																							
AL <i>Ilisha flavipinnis</i> (Valenciennes). ⁶																×							
A <i>Pristigaster cayanus</i> Cuvier. ⁶																							
A <i>Osteoglossum bicirrosus</i> Agassiz.	×	×	×					×															
A <i>Arapaima gigas</i> Cuvier.	×	×						×											×				
* <i>Rivulus geayi</i> Vaillant.																					×		
A <i>R. urophthalmus</i> Günther.																			×				
<i>R. micropus</i> Steind.																				×			
<i>R. obscurus</i> Garman.				×																			
A <i>Anableps anableps</i> (Linnæus). ⁸				×	?	?	?	?						?		×							
A <i>A. microlepis</i> Garman.					?	?	?	?						?		×			×				
AL <i>Pacilia vivipera</i> Bloch & Schneider.				×	?	?	?	?								×			×				
me * <i>Tylosurus microps</i> (Günther).																×							
me A <i>T. almeida</i> Quoy & Gaimard.																×							
AL <i>Potamorhaphis guianensis</i> Schomburgk.																		×	×				
me * <i>Polycentrus schomburgkii</i> Müller & Troschel.								×															
A <i>Plagioscion squamosissimus</i> (Heckel). ⁹				×				?															
<i>P. heterolepis</i> (Bleeker).																×							
A <i>P. surinamensis</i> (Bleeker).																×							

¹ All rivers of British Guiana. ² British Guiana. ³ British Guiana. ⁴ French Guiana. ⁵ In all fresh waters of British Guiana. ⁶ Entering rivers. ⁷ Upper courses? ⁸ Mouths of rivers of British Guiana. ⁹ Rivers of Guiana.

	Rio Branco.	Takutu.	Lake Amucu.	Orinoco.	Barima.	Waini.	Pomeroon.	Essequibo.	Cuyuni.	Mazaruni.	Rupununi Rewa.	Cuyuwini.	Demerara.	Berbice.	Corentine.	Surinam.	Maroni.	Mana.	Cayenne and Mahuey.	Carsevenne.	Lunier.	Carnot.	Cachipour.
SA <i>Pachyurus schomburgkii</i> (Günther).	×															×							
A <i>Pachypops furcraeus</i> (Lacépède).																×							
A <i>P. trifilis</i> (Müller & Troschel). ¹	×															×							
A <i>Chaetobranchus flavescens</i> Heckel.	×		×																				
A <i>Cichla ocellaris</i> Bloch & Schneider.	×			×				×								×							
A <i>Cichla temensis</i> Humboldt.	×			×																			
A <i>Uaru amphiacanthoides</i> Heckel.																							
A <i>Acaropsis nassa</i> (Heckel).				×				×					×								×		
AL <i>Astronotus ocellatus</i> (Agassiz).	×																						
A <i>Æquidens vittata</i> (Heckel).				×																		×	
A <i>Æ. tetramerus</i> (Heckel).	×							×												×		×	
* <i>Æ. geayi</i> (Pellegrin).								×											×			×	
* <i>Æ. maronii</i> (Steindachner).													×			×	×						
<i>Æ. guianensis</i> (Regan). ²																							
** <i>Nannacara anomala</i> Regan.								×															
A <i>Cichlasoma bimaculatum</i> (Linnæus).				×									×	×									
A <i>C. temporale</i> (Günther). ³															×			×					
A <i>C. festivum</i> (Heckel).				×									×										
A <i>C. severum</i> (Heckel). ⁴																							
A <i>C. psittacum</i> (Heckel).				×																			
A <i>Crenicara punctulata</i> Günther.																							
L <i>Batrachops semifasciatus</i> Heckel.				×				×															
* <i>B. punctulatus</i> Regan.								×															
A <i>B. reticulatus</i> Heckel.								×															
A <i>Crenicichla saxatilis</i> (Linnæus).								×					×	×		×			×	×		×	
<i>C. wallacii</i> Regan.								×															
* <i>C. multispinosa</i> Pellegrin.																×							
AL <i>C. vittata</i> Heckel.																				×			
A <i>C. lenticulata</i> Heckel.				×																			
A <i>C. lugubris</i> Heckel.				×				×															
A <i>C. johanna</i> Heckel. ⁵				×																			
A <i>Geophagus surinamensis</i> Bloch.																×							
* <i>G. camopiensis</i> Pellegrin. ⁶																							
AL <i>G. jurupari</i> Heckel. ⁷																							
A <i>G. cupido</i> Heckel.								×															
A <i>Satanoperca pappaterra</i> (Heckel).																							
* <i>Pterophyllum altum</i> Pellegrin.				×																			
A <i>Colomesus psittacus</i> Bloch & Schneider.																							

¹ Along the coast of British Guiana.⁵ British Guiana.² Guiana.⁶ French Guiana.³ Guiana.⁷ Guiana.⁴ Guiana.

6. *Trinidad Province.*

The fauna of Trinidad is of peculiar interest. Trinidad is an island off the delta of the Orinoco, approximately 40 by 50 miles. Its geographical affinity is with Venezuela rather than with Guiana. Its fresh-water fauna consists of three elements:

1. West Indian, 16+ per cent. (about). This element consists chiefly of members of the Gobiidæ which enter fresh water throughout tropical America.

2. Amazonian, 33 per cent. This element consists, with few exceptions, of species ranging from the La Plata basin to Trinidad. The exceptions are found in the Amazon and Trinidad. All are marked A.

3. Autochthonous, 33 per cent. This element consists either of local adaptations, *, of genera with a very wide distribution, or of distinct genera marked **.

Me *Selenaspis herzbergii* (Bloch). Trinidad to Brazil.

Me *Tachisurus laticeps* Günther. British Guiana, Trinidad.

A *Rhamdia sebæ kneri* Steindachner. Paraguay to Trinidad.

* *Pseudauchenipterus guppyi* (Regan). Trinidad.

* *Trachycorystes paseæ* (Regan). Trinidad.

A *Ancistrus cirrhosus* Cuvier & Valenciennes. Rio Grande do Sul to Trinidad.

* *Hemiancistrus trinitatis* (Günther). Trinidad.

A *Plecostomus robinii* Cuvier & Valenciennes. La Plata to Trinidad.

A *Plecostomus plecostomus* (Linnæus). Eastern South America.

A *Callichthys callichthys* (Linnæus). La Plata to Trinidad.

A *Hoplosternum littorale* Hancock. La Plata to Trinidad.

A *Hoplosternum thoracatum* (Cuvier & Valenciennes). Eastern South America.

* *Corydoras æneus* Gill. Trinidad.

A *Hoplias malabaricus* (Bloch). La Plata to Magdalena.

A *Hoplerythrinus unitaeniatus* (Spix). La Plata to Trinidad.

* *Curimatus argenteus* Gill. Trinidad.

* *Odontostilbe pulcher* (Gill). Trinidad.

A *Hemigrammus unilineatus* Gill. Trinidad to Bahia.

* *Hemibrycon tæniurus* (Gill). Trinidad.

* *Hemibrycon guppyi* (Regan). Trinidad.

- A* *Astyanax bimaculatus* (Linnæus). La Plata to Panama.
 ** *Stewardia albipinnis* Gill. Trinidad.
A *Gymnotus carapo* Linnæus. La Plata to Rio Motagua.
A *Symbranchus marmoratus* Bloch. La Plata to Cuba.
 * *Haplochilus harti* (Boulenger). Trinidad.
 * *Acanthophaeus guppieri* (Günther). Trinidad.
W *Doryhamphus lineatus* Valenciennes.
W *Agonostomus monticola* (Bancroft). West Indies, Trinidad.
Me *Mugil brasiliensis* Agassiz.
Me *Mugil trichodon* Poey.
W *Centropomus ensiferus* Poey.
W *Centropomus undecimalis* Bloch.
 Polycentrus schomburgkii Müller & Troschel. Trinidad.
 Æquidens pulchrum (Gill.) Chagres, Trinidad.
A *Cichlasoma bimaculatum* (Linnæus). Paraguay to Trinidad.
A *Crenicichla saxatilis* (Linnæus). Amazon to Trinidad.
W *Dormitator maculatus* Bloch.
W *Philypnus dormitator* (Lacépède).
 ** *Evorthodus breviceps* Gill. Trinidad and Surinam.
W *Chonophorus banana* (Cuvier & Valenciennes).
 * *Gobius fasciatus* (Gill). Trinidad.

7. Southeast or East Brazilian Plateau.

The southern land-mass, Archamazona, the Brazilian plateau, is drained by the Tocantins, Rios San Francisco, Doce, Jequitinhonha, Parahyba and other coast streams and the upper tributaries and head-waters of the Parana. The rivers leave this mass over important falls. The Parana is part of the La Plata system, and as far as it may be considered, will be taken up with the La Plata.

This old land-mass was doubtless more extensive in the past. The isolated ranges or peaks in the territory west of the Araguay are the probable remnants of the formerly more extensive plateau. The falls in the Tocantins, Xingu, Tapajos and Madeira mark the probable northern and western boundary of this plateau. However, west of the Rio San Francisco, the streams all drain into the Amazon and their fauna could not have retained its original character. The western streams probably con-

tributed to the Amazonian fauna when the latter was formed and received in turn new Amazonian types.

The fauna of eastern Brazil differs much more from that of the Amazon than does that of the equally old Guiana. By eastern Brazil is here understood the northeastern part of this old land-mass, *i.e.*, the territory north of the Parana basin and between the eastern watershed of the Tocantins and the coast south from Cape San Roque to the Iguape. The entire territory has an average height of about 2,000 feet. North of the Parahyba it is in the form of two wide terraces, besides the coastal plain. The western terrace is occupied by the San Francisco basin; it is separated from the eastern narrower terrace by a series of Serras beginning with the Serra da Tuila, near the mouth of the San Francisco, and ending in the Serra do Espinhaco near Rio de Janeiro. In these Serras and the table-land or middle terrace to the east of them are the sources and middle courses of a number of rivers with a general west to east course.

This middle terrace is bordered on the east by the coast ranges extending from the Parahyba north. Through it all of the rivers of the region have broken their path and in it all of them have extensive falls.

These streams with the tributaries and localities where collections have been made are: (1) Rio Paraguassu, emptying at Bahia; (2) Rio de Contas; (3) Rios Jundiahe, Salsa, Pardo and Jequitinhonha (with its tributary Arrasuahy) emptying at Cannavieras; (4) Rio Mucury on which are located Porto Alegre and Santa Clara; (5) Rio de San Matheos; (6) Rio Doce and its tributary Rio San Antonio; (7) Rio Quenda, emptying at Santa Cruz; (8) Rio Itabapuana.

Farther south we have: (9) Rio Parahyba with its tributaries Piabanhã, Pirahy, Muriahe, Pampa and Preto (Campos; Juiz de Fora; Mendez; Taubaté); (10) Macahe; (11) Rio de Janeiro; (12) Santos and Alto da Serra; (13) Iguape.

The Parahyba, Santos and Iguape are opposite to the Parana basin, all the others to the San Francisco. The trend of the Parahyba is different from that of the coastwise streams to the north of it. It flows first southwest, then northeast parallel with the coast range and between it and the Serra de Mantegueira. Von Ihering has suggested that the peculiar trend of the upper course of the Parahyba and some of its tributaries indicates that these were formerly tributaries of the Rio Tieté and were captured from it by the Parahyba. A partial comparison of the faunas of the Tieté and

Parahyba is possible, and will be given in the lists of species of this region.

The San Francisco, which occupies the western terrace and flows at right angles to the coastwise streams to near the 9th degree of latitude, where it also turns to the east, is the largest river. It has a length of 2000 km. and a basin of 652,000 square kilometers. Its origin is at an elevation of 1200 m., and about its headwaters "are some of the highest elevations in Brazil." It has an upper fall of 15 m. near Pirapora and a lower fall of 80 m. at Paulo Alfonso.

The fish fauna of this area has become known, first, through the work of Lütken, who has published an excellent account of the fishes of the Rio das Velhas, an upper tributary of the Rio San Francisco; second, through Steindachner, who has published accounts of the fishes of the coastwise streams, Steindachner basing his account on the very extensive collections made in the lower and upper courses of all the streams by Agassiz and his assistants, and through Eigenmann who has written on the fishes at Taubaté and the Rio Tieté.

The fauna of this area as a whole is distinguished by the absence of certain Amazonian forms. It is of increased interest because many genera absent from this area are found in the La Plata basin as well as in the Amazon basin, having evidently reached the La Plata through the interior waterway rather than from stream to stream along the coast.

8. *The San Franciscan Province.*

The Rio San Francisco being nearer the Amazonian Province has a larger proportion of Amazonian genera than the streams south of Bahia. Notably the Serrasalmoninæ and the Gymnotidæ, present in the San Francisco, are not recorded from the coast streams. It forms a faunal province distinct from the rest of the area to the east.

The following species have been recorded from the Rio San Francisco and its tributaries, the Rio Preto and Rio das Velhas, and the Rio Cipo, a tributary of the Velhas.

EXPLANATION OF MARKINGS USED.

L Also found in the La Plata Basin.

A Also found in the Amazons.

* Species peculiar to the San Francisco.

- ** Genus and species peculiar to the San Francisco.
- / Species peculiar to eastern Brazil.
- // Genus and species peculiar to eastern Brazil.
- AL *Pseudopimelodus zungaro* (Humboldt).
- L *Rhamdia hylarii* (Cuvier & Valenciennes).
- * *Rhamdella microcephala* (Reinhardt).
- / *Rhamdella minuta* (Lütken).
- AL *Pimelodella lateristriga* (Müller & Troschel).
- / *Pimelodella vittata* (Kröyer).
- AL *Pimelodus clarias* (Bloch).
- L *Pimelodus valenciennis* Kröyer.
- AL *Pimelodus fur* (Reinhardt).
- ** *Bergiaria westermanni* (Reinhardt). Genus not in Guiana.
- * *Conorhynchus conirostris* (Cuvier & Valenciennes). Genus not in Guiana.
- ** *Bagropsis reinhardti* Lütken. Genus not in Guiana.
- ** *Duopalatinus emarginatus* (Cuvier & Valenciennes). Genus not in Guiana.
- L *Pseudoplatystoma coruscans* (Agassiz).
- * *Doras marmoratus* Reinhardt.
- AL *Doras costatus* (Linnæus).
- A *Oxidoras niger* (Valenciennes).
- A *Glanidum albescens* Reinhardt. Genus not in Guiana.
- AL *Trachycorystes galeatus* (Linnæus).
- * *Pseudauchenipterus flavescens* (Eigenmann & Eigenmann).
- L *Pygidium brasiliensis* (Reinhardt).
- * *Stegophilus insidiosus* Reinhardt. Genus not in Guiana.
- L *Plecostomus commersoni* (Valenciennes).
- * *Plecostomus garmani* Regan.
- / *Plecostomus wuchereri* Günther.
- * *Plecostomus macrops* Eigenmann & Eigenmann.
- * *Plecostomus alatus* Castlenau.
- AL *Plecostomus vaillanti* Steindachner.
- / *Plecostomus auroguttatus* (Kner.).
- * *Pterygoplichthys etentaculatum* (Spix.).
- / *Pterygoplichthys lituratus* (Kner.).
- L *Rhinelepis aspera* Spix. Genus not in Guiana.

- | *Loricaria steindachneri* Regan.
- * *Loricaria nudiventris* Cuvier & Valenciennes.
- AL *Hoplias malabaricus* (Bloch).
- A *Hoplerythrinus salvus* (Agassiz).
- * *Curimatella lepidurus* Eigenmann & Eigenmann. Below the falls.
- L *Curimatus gilberti* Quoy & Gaimard.
- * *Prochilodus affinis* Reinhardt.
- AL *Parodon suborbitalis* Cuvier & Valenciennes. Genus not in Guiana.
- A *Hemiodus gracilis* Günther.
- L *Anostomus isognathus* Kner.
- AL *Characidium fasciatum* Reinhardt.
- * *Leporinus tæniatus* Lütken.
- * *Leporinus reinhardti* Lütken.
- AL *Leporinus frederici* Bloch.
- A *Leporellus vittatus* Cuvier & Valenciennes. Genus not in Guiana.
- * *Cheirodon piaba* Lütken. Genus not in Guiana.
- * *Hemigrammus santæ* Eigenmann.
- AL *Hemigrammus gracilis* (Reinhardt).
- * *Hemigrammus nanus* (Reinhardt).
- * *Mœnkhausia costæ* Steindachner.
- AL *Astyanax bimaculatus lacustris* (Lütken).
- AL *Astyanax fasciatus* (Cuvier).
- * *Astyanax scabripinnis rivularis* (Lütken).
- | *Brycon carphagus* Cuvier & Valenciennes.
- * *Brycon lundii* Lütken.
- AL *Brycon hilarii* (Cuvier & Valenciennes).
- | *Brycon reinhardti* Lütken.
- * *Creagrutus argenteus* Reinhardt. Genus not in Guiana.
- A *Chalcinus güntheri* Garman.
- AL *Pygocentrus piraya* Cuvier.
- AL *Serrasalmo marginatus* Valenciennes.
- * *Myleus micans* Lütken.
- * *Myleus altipinnis* Cuvier & Valenciennes.
- A *Ræboides xenodon* Lütken.
- AL *Salminus hilarii* Cuvier & Valenciennes. Genus not in Guiana.
- A *Salminus brevidens* Cuvier.
- * *Acestrorhynchus lacustris* (Lütken).

- L *Sternarchus brasiliensis* Reinhardt.
AL *Eigenmannia virescens* (Valenciennes).
AL *Sternopygus macrurus* Müller & Troschel.
AL *Gymnotus carapus* Linnæus.
? *Synbranchus*.
? *Arapaima*.
A *Pachyurus squamipinnis* Agassiz.
* *Pachyurus francisci* Cuvier & Valenciennes.
L *Citharichthys spilopterus* Günther. Marine.

While this list shows many species and several peculiar genera as a whole, except for the absentees of many Amazonian genera and species, the fauna of this river does not differ more from that of the Amazon at Para than that of Para differs from the fauna of the Amazon at Tabatinga. Its fauna is much more like that of the Amazon than the fauna of the Colorado is like that of either the Rio Grande or the Lerma. A certain number of genera and species may always be expected to be peculiar.

Has this area a primitive fauna and did it serve as a center of distribution? If the theory of the population of the lowland streams from these ancient highlands is correct, we may reasonably infer that the genera now occupying this region are part of the ancient fauna. The San Francisco, occupying an isolated position in the very center of the old land mass, may serve as the basis of the discussion. Only the fresh-water families are of consequence in this discussion. The *Bunocephalidæ*, *Arapaimidæ*, *Lepidosirenidæ*, *Osteoglossidæ*, and *Argiidæ* are absent. Some of these, as the *Argiidæ*, might have developed from other forms that may have emigrated from this place, but not so the others. For these others the Brazilian plateau cannot have been the center of divergence. This is also the case with the *Serrasalmoninæ*, *Mylinæ* and *Gymnotidæ*. These are found in the San Francisco, but not in the coastwise streams east of the San Francisco basin. Have they in the past migrated from this place as a center? Possibly, but probably not, for while these are found to the west, north, and south of the San Francisco basin, they are not found to the east in the coastwise streams. It is, therefore, very probable that the San Francisco obtained these forms from the west, where they swarm and from where the south certainly obtained them, and that they have not yet succeeded in crossing the eastern boundary of the San Francisco. It is less probable that they migrated

from the San Francisco westward and not eastward. This applies with equal force to all other San Franciscan genera found in the Amazon and not in the coastwise streams.¹

How is it with the genera *Pseudoplatystoma*, *Rhamdia*, *Rhamdella*, *Pimelodella*, *Pimelodus*, *Astyanax* and all the other genera of the San Francisco that have a wide distribution?¹ These probably belong to the original fauna, or had their origin in the San Francisco, or rather Brazilian plateau and have become distributed from it. Guiana has of course an equal claim on them; and there is no evidence that they have become distributed from the San Francisco rather than from Guiana.

There remain only the genera peculiar to the region, and, inasmuch as they have not become distributed they do not enter the question.

There is some evidence that part of the San Francisco fauna has been derived from the Amazon basin. This evidence consists of the fact that the San Francisco, which is nearer the Amazon basin, contains a larger number of Amazonian genera than the eastern streams, and in part, of the fact that the peculiarly lowland forms of the Amazon have not reached this province, and in part, of the presumption in favor of the Amazon because it has unquestionably acted as the center of distribution of many lowland forms that have reached the La Plata basin without entering the province under consideration.²

It is very probable that the San Francisco has contributed to the fauna to the south of it (see under the La Plata, etc.).

9. *The Coastal Province.*

The fauna of the second terrace and coastal plain from Bahia to Iguapé, whose rivers were described in a preceding section, shows a proportion of species peculiar to the region about equal to the proportion of peculiar species in the Pacific province, not considering marine derivatives and Pœciliidæ. There are eight peculiar genera, as compared with three in the Pacific province. This area contains a very much larger percentage of species that are also found in the Amazon than does the Magdalena.

Fifty genera present in the Amazon and La Plata basins are absent from the large streams between Bahia and Rio de Janeiro; over thirty of these are also absent from the San Francisco. They demonstrate their migra-

¹ See in the Guiana list those marked with an S.

² Mr. Haseman reports an open road for the passage of fishes from the Tocantins.

tion into the La Plata basin from the Amazon by some inland route, and that for the thirty and more genera at least, that are absent from this area and from the San Francisco, this territory could not have been the center of dispersal.

The fifty genera thus present in the Amazon and La Plata and absent from the coastal rivers exceed the total number of genera recorded from them.

The following genera found in the La Plata and Amazon have not been found in the coastwise streams. Those not recorded from the Magdalena are marked +; those not in the San Francisco X.

X + <i>Bunocephalus</i> ,	+ <i>Curimatella</i> ,	+ <i>Serrasalmo</i> ,
X + <i>Dysichthys</i> ,	X + <i>Anodus</i> ,	X + <i>Piaractus</i> ,
<i>Pimelodus</i> ,	+ <i>Parodon</i> ,	X + <i>Metynnis</i> ,
X + <i>Luciopimelodus</i> ,	+ <i>Hemiodus</i> ,	+ <i>Myleus</i> ,
<i>Pseudoplatystoma</i> ,	X + <i>Anisitsia</i> ,	X + <i>Colossoma</i> ,
X + <i>Paulesca</i> ,	X + <i>Nannostomus</i> ,	X + <i>Mylossoma</i> ,
X <i>Sorubim</i> ,	<i>Anostomus</i> ,	X + <i>Charax</i> ,
? <i>Doras</i> ,	+ <i>Charax</i> ,	X + <i>Roestes</i> ,
+ <i>Oxydoras</i> ,	<i>Leporellus</i> ,	<i>Ræboides</i> ,
+ <i>Centromochlus</i> ,	X + <i>Holoshesthes</i> ,	<i>Cynopotamus</i> ,
+ <i>Stegophilus</i> ,	X + <i>Odontostilbe</i> ,	<i>Salminus</i> ,
X <i>Cetopsis</i> ,	<i>Cheirodon</i> ,	+ <i>Acestrorhynchus</i> ,
X <i>Ageneiosus</i> ,	X + <i>Aphyocharax</i> ,	<i>Eigenmannia</i> ,
X + <i>Hoplosternum</i> ,	+ <i>Hemigrammus</i> ,	<i>Gymnotus</i> ,
X + <i>Hemiodontichthys</i> ,	X + <i>Gasteropelecus</i> ,	+ <i>Giton</i> ,
X + <i>Sturisoma</i> ,	<i>Chalcinus</i> ,	X <i>Æquidens</i> ,
X + <i>Hypoptopoma</i> ,	X + <i>Piabucus</i> ,	X + <i>Biotodoma</i> ,
X + <i>Pyrrhulina</i> ,	X + <i>Pygopristis</i> ,	X + <i>Cichlosoma</i> .
X + <i>Psectrogaster</i> ,	+ <i>Pygocentrus</i> ,	

This area is also characterized by positive features, for we have the genera *Steindachneria*, *Pogonopoma*, *Wertheimeria*, *Hemipsilichthys*, *Del-turus*, *Parotocinclus*, *Deuterodon*, *Henochilus*, *Harttia*, *Hollandichthys*, *Typhlobagrus*, *Cædurichthys*, *Kronichthys*, peculiar to this province.

In the number of peculiar genera this province differs more from the Amazon than does that across the Andes in Ecuador and Peru (see p. 312) and if the degree of difference is a criterion, it is an older fauna.

List of Species With Their Known Distribution.

In the following list:

A indicates that the species has been recorded from the Amazon.

L indicates that the species has been recorded from the La Plata, including Rio Grande do Sul.

* that the species is peculiar to this province.

** that the genus is peculiar to this province.

All the observations on the San Francisco basin as a possible center of distribution apply with equal force on the coastal province.

There are two facts that deserve emphasis: First at Taubaté, in the State of São Paulo on the Rio Parahyba, fossil fishes have been found in bituminous shales. The definite geological horizon of these rocks has not been determined and they contain no other fossils. These fossils belong, according to Smith Woodward, to the genera *Arius*, a genus now very abundant along the coasts of tropical America and entering fresh water; *Tetragonopterus*, or its ally *Astyanax*, still abundant in the Parahyba; *Percichthys*, now confined to the Patagonian region, and *Acara*, a Cichlid. Von Ihering contends that the *Percichthys* is not a member of the *Serranidae* to which *Percichthys* belongs, but is a *Cichlid*, and Jordan makes a new genus *Eobrycon* of the fossil *Tetragonopterus*.

Von Ihering is inclined to the opinion that the shales were deposited during the Tertiary in a lake more than 120 km. long, occupying the valley of the Parahyba from the Serra de Mantiqueira to that of Bocaina.

Second, while there are many genera in the Amazon and the La Plata not found in eastern Brazil, there are also a number of species in the La Plata basin and eastern Brazil that have not been found in the Amazon. These are enumerated in the list of species of the coastwise streams and indicate that there has been a certain amount of migration between the La Plata and this region. The possible means of communication is indicated in the description of the Parahyba.

	Tieté.	Rio Grande do Sul.	Ribeira. ¹	Santos.	Joaó.	Rio de Janeiro	Macabé.	Parahyba.	Itabapua.	Quenda.	Doce.	S. Matheos.	Mucury.	Porto Seguro.	Jequitinhonha	Pardo.	Bahia and Paraguassu.
LA <i>Genidens genidens</i> (Cuv. & Val.).		×		×		×						×	×	×			
* <i>Pseudopimelodus parahybæ</i> Steindachner.								×		×							
A <i>P. raninus</i> (Cuv. & Val.).						×											
A <i>Rhamdia sebæ</i> (Cuv. & Val.).						×				×	×	×					×
LA <i>R. quelen</i> (Quoy & Gaim.).	×	×				×		×		×	×	×	×		×		×
* <i>Rhamdella exsudans</i> (Jenyns).						×											
L <i>R. jenynsii</i> (Günther).						×											
* <i>R. minuta</i> (Lütken).						×											
* <i>Acetronichthys leptos</i> E. & E.												×					
A <i>Pimelodella cristatus</i> (Müller & Trosch.).													×				
* <i>P. pectinifer</i> E. & E.								×					×				
LA <i>P. lateristriga</i> (Müller & Troschel).		×				×		×			×	×	×		×		
* <i>P. harttii</i> (Steindachner).								×									
* <i>P. eigenmanni</i> (Boulenger).								×									
* <i>Conorhynchus glaber</i> (Steind.).														×			
A <i>Brachyplatystoma vaillanti</i> (Cuv. & Val.).								×									
** <i>Steindachneria amblyura</i> Eigenmann & Eigenmann.															×		
* <i>S. doceana</i> E. & E.											×						
* <i>S. parahybæ</i> (Steindachner).								×									
** <i>Wertheimeria maculata</i> Steindachner.															×		
A <i>Glanidium albescens</i> Reinhardt.							×	×									
LA <i>Trachycorystes striatulus</i> (Steindachner).								×	×	×	×	×	×				
* <i>Pseudauchenipterus jequitinhonhæ</i> (Steindachner).															×		
A <i>P. affinis</i> (Steindachner).												×	×				
A <i>P. nodosus</i> (Bloch).																	×
L <i>Pygidium brasiliensis</i> (Reinhardt).								×		×							
** <i>Scleromystax barbatus</i> (Quoy & Gaimard).						×											
LA <i>Callichthys callichthys</i> Linnæus.						×		×									×
* <i>C. arcifer</i> Hensel.						×		×									
* <i>Corydoras nattereri</i> Steindachner.						×		×			×						
* <i>Plecostomus punctatus</i> Cuv. & Val.		×						×	×	×							
* <i>P. unæ</i> Steindachner.								×									×
L <i>P. wuchereri</i> Günther.						×		×									×
* <i>P. lütkeni</i> Steindachner.								×		×	×		×				×
** <i>Pogonopoma wertheimeri</i> (Steindachner).													×				
* <i>Rhinelepis parahybæ</i> Steindachner.								×									
** <i>Hemipsilichthys gobio</i> (Lütken).				×				×									
** <i>Delturus angulicauda</i> (Steindachner).								?					×				
* <i>D. parahybæ</i> E. & E.								×				×					
A <i>Ancistrus stigmaticus</i> E. & E.																	
* <i>Otocinclus affinis</i> Steindachner.											×						
* <i>O. notatus</i> E. & E.											×						
** <i>Parotocinclus maculicauda</i> (Steindachner).											×						
* <i>Microlepidogaster lophophanes</i> (E. & E.).											×						
* <i>Loricaria nigricauda</i> Regan.						×											
A <i>L. konopickyi</i> Steindachner.						×											
<i>L. steindachneri</i> Regan (San Francisco.)								×		×							
A <i>L. lima</i> Kner.								×									
?A <i>L. acuta</i> Castelnau.						?											
* <i>L. spixii</i> Steindachner.								×		×		×					
* <i>Harttia loricariformis</i> Steind.								×									
A <i>Neoplecostomus granosus</i> (Cuv. & Val.).						×		×									

¹ For a list of the species of this river see page 372.

	Tieté.	Rio Grande do Sul.	Ribeira.	Santos.	Joaó.	Rio de Janeiro	Macahé.	Parahybá.	Itabapana.	Quenda.	Doce.	S. Matheos.	Mucury.	Porto Seguro.	Jequitinhonha	Pardo.	Bahia and Paraguassu.
LA <i>Hoplias malabaricus</i> (Bloch).	×		×			×		×		×	×	×	×		×		×
LA <i>Hoplerythrinus unitaniatus</i> (Spix).						×		×			×	×					×
A <i>Erythrinus erythrinus</i> (Bloch).						×											
* <i>Curimatus elegans</i> Steindachner.															×		×
* <i>C. elegans bahiensis</i> E. & E.																	×
L <i>C. gilberti</i> Quoy & Gaimard.						×		×	×			×	×				
* <i>C. nagelii</i> Steindachner.						×											
* <i>Prochilodus vimbooides</i> Heckel.								×			×	×					
* <i>P. brevis</i> Steindachner.																	
* <i>P. hartii</i> Steindachner.															×	×	
L <i>P. scrofa</i> Steindachner.	×					×		×									
L <i>Characidium fasciatum</i> Reinhardt.						×		×									
* <i>Leporinus macrolepidotus</i> Peters.						×		×									
A <i>L. melanopleura</i> Günther.																	×
A <i>L. megalepis</i> Günther.						×											×
A <i>L. bimaculatus</i> Castelnau.								×									
* <i>L. steindachneri</i> Eigenmann.															×		
LA <i>L. frederici</i> (Bloch).								×									×
* <i>L. bahiensis</i> Steindachner.																	×
L <i>L. copelandi</i> Steindachner.	×							×		×	×	×			×		
* <i>L. mormyrops</i> Steindachner.								×									
L <i>L. conirostris</i> Steindachner.								×			×	×					
* <i>L. macrolepidotus</i> Peters.						×					×		×				
* <i>Tetragonopterus gibbosus</i> Steindachner.								×									
A <i>Fowlerina orbicularis</i> Cuv. & Val.								×									
* <i>Mænkhausia doceanus</i> (Steindachner).											×						
LA <i>Astyanax bimaculatus</i> (Linnæus).	×	×						×			×	×					×
* <i>A. janeiroensis</i> Eigenmann.						×							×				
LA <i>A. fasciatus</i> (Cuvier).			×			×		×	×					×			×
* <i>A. fasciatus parahybæ</i> Eigenmann.								×									
* <i>A. fasciatus jequitinhonhæ</i> Steindachner.								×							×		
* <i>A. brevirostris</i> Eigenmann.															×		
* <i>A. giton</i> Eigenmann.								×									
* <i>A. bahiensis</i> (Steindachner).																	×
* <i>A. scabripinnis</i> (Jenyns).						×		×									
* <i>A. scabripinnis laticeps</i> (Cope).		×						×									
* <i>A. scabripinnis longirostris</i> Steindachner.																	
* <i>A. scabripinnis intermedius</i> Eigenmann.								×			×	×					
* <i>A. eigenmanniorum</i> (Cope).		×											×				
L <i>A. taniatus</i> (Jenyns).						×		×						×			
** <i>Henochilus wheatlandi</i> Garman.													×				
* <i>Hollandichthys multifasciatus</i> (Eigenmann & Norris).				×													
* <i>Deuterodon rosæ</i> (Steindachner).				×													
* <i>D. pedri</i> Eigenmann.		×															
* <i>D. parahybæ</i> Eigenmann.								×									
* <i>D. iguape</i> Eigenmann & Norris.				×													
* <i>Brycon ferox</i> Steindachner.												×					
* <i>B. devillei</i> Castelnau.															×		×
* <i>B. reinhardti</i> Lütken.								×			×						
* <i>Paragoniates microlepis</i> Steindachner.						×											
* <i>Acestrorhamphus macrolepis</i> (Steindachner).															×		

¹ Cubatao.

	Tieté.	Rio Grande do Sul.	Ribeira.	Santos.	João.	Rio de Janeiro	Macahé.	Parahyba.	Itabapua.	Quenda.	Doce.	S. Matheos.	Mucury.	Porto Seguro.	Jequitinhonha.	Pardo.	Bahia and Paraguassu.
L <i>A. jenynsii</i> (Günther).						×											
L <i>A. hepsetus</i> (Cuvier).								×			×						×
LA <i>Synbranchus marmoratus</i> Bloch.																	×
A <i>Arapaima gigas</i> Cuvier.																	×
* <i>Pachypops adspersus</i> Steindachner.								×			×		×				
L <i>Cichlasoma facetum</i> Jenyns.			×	×				×									
L <i>C. autochthon</i> Günther.					×			×			×	×					
A <i>C. severus</i> Heckel.								×									
L <i>Crenicichla lacustris</i> Castelnau.			×	×	×	×	×	×									×
L <i>Geophagus brasiliensis</i> Quoy & Gaimard.	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×		×
<i>G. gymnogonys</i> Hensel.				×													

10. *The La Plata Province.*

Of the streams draining toward the south nothing is known ichthyologically of the Uruguay and very little of the upper Parana, while the Paraguay, owing to the work of Natterer, Ternetz and Anisits, is one of the best known regions of South America.

The Paraguay is a lowland stream, the elevation at its sources at Cuyaba being but 200 m. At Corumba it has an elevation of 140 m., at Puerto Pachero 100 m., at Asuncion it has an elevation of about 70 m. Its sources are in contact with the sources of the Guaporé, a tributary of the Madeira, and those of the Tapajos.

The upper Parana is, in distinct contrast to the Paraguay, a mountain stream arising in the Serra da Mar and the southward extension of the San Francisco plateau. The Rio Grande de Minas, one of its largest tributaries, has at Porta da Rifano an elevation of 590 m. The upper Parana is separated from the lower Parana by the Gran Salto de Guaira, where it leaps over falls of 18 m. to the lowland. Its upper tributaries arise mostly in the coast range near the Atlantic coast and reach the main stream after numerous falls.

A list of the fishes of the Paraguay basin is sufficiently startling on account of the few things peculiar to it, and the many species and genera it has in common with the Amazon, to warrant giving it in detail.

A separate list of species and genera for the Parana, La Plata and Rio Grande do Sul gives us an idea of the relationship of the fauna to that of the Amazon and to that of southeastern Brazil.

There is no room for doubt on the source of the fish fauna of this

region. It came from the north, in small part from the eastern plateau, in greater part from the Amazon valley. The question of the time of the origin of the fauna is of interest. The only observations, as far as I know, directly bearing on this question are those of A. Smith Woodward, 1900, who recorded from the Parana formation fragments of "*Arius*, *Pimelodus*, *Platystomus* and other genera which still live in the freshwaters of South America" and also fragments of characinoids. The formation is a *marine* deposit, near the city of Parana, which he thinks "is truly of late Tertiary age, and may probably be correlated with the Pliocene of the northern hemisphere." As these deposits contain remains of land-mammals, sharks' teeth and fresh-water fishes it is probably an estuary deposit of the former mouth of the Parana river. The present fauna of this stream developed with the stream itself.

LIST OF FISHES RECORDED FROM THE PARAGUAY BASIN.

In the following list, "*" indicates that the species is peculiar to the Paraguay basin; "***" that both the genus and species are peculiar; "A" indicates that the species is also found in the Amazon basin; "a" the genus is found in the Amazon basin; and "/" that the species is peculiar to the La Plata. "C" that it is also found in the coast streams of Eastern Brazil and "S" that it is also found in the San Francisco.

A *Potamotrygon hystrix* Müller & Troschel.

A *Potamotrygon dumerilii* Castelnau.

a* *Dysichthys australe* Eigenmann & Ward.

a* *Bunocephalus rugosus* Eigenmann & Kennedy.

a/ *Bunocephalus iheringii* Boulenger.

a* *Bunocephalus doriae* Boulenger.

A *Pinarampus pirinampu* (Spix).

A *Luciopimelodus platanus* Günther.

AS *Pseudopimelodus zungaro* (Humboldt).

* *Pseudopimelodus cottoides* Boulenger.

/ *Heptapterus mustelinus* Valenciennes.

AC *Rhamdia quelen* (Quoy & Gaimard).

A *Rhamdia sebæ kneri* Steindachner.

A *Pimelodus ornata* Kner.

* *Pimelodus albicans* (Cuvier & Valenciennes).

AS *Pimelodus clarias* (Bloch).

- S *Pimelodus valenciennis* (Kröyer).
 AS *Pimelodus fur* Reinhardt.
 ** *Iheringichthys labrosus* (Lütken).
 ** *Iheringichthys megalops* Eigenmann & Ward.
 A *Pimelodella gracilis* (Valenciennes).
 * *Pimelodella tæniophorus* Regan.
 ACS *Pimelodella lateristriga* (Müller & Troschel).
 * *Pimelodella mucosa* Eigenmann & Ward.
 A *Sciades pictus* (Müller & Troschel).
 A *Hemisorubim platyrhynchus* (Cuvier & Valenciennes).
 aS *Pseudoplatystomus coruscans* (Agassiz).
 A *Sorubim lima* (Bloch & Schneider).
 A *Doras granulosus* Valenciennes.
 AS *Doras costatus* (Linnæus).
 * *Doras maculatus* Valenciennes.
 * *Doras nebulosus* Eigenmann & Kennedy.
 A *Doras weddellii* Castelnau.
 / * *Oxydoras knerii* (Bloch).
 * *Oxydoras eigenmanni* (Boulenger).
 * *Hemidoras paraguayensis* Eigenmann & Ward.
 aA *Tracheliopterus coriaceus* (Cuvier & Valenciennes).
 * *Auchenipterus nigripinnis* (Boulenger).
 AS *Trachycorystes galeatus* (Linnæus).
 AC *Trachycorystes striatulus* Steindachner.
 A *Ageneiosus valenciennesi* Bleeker.
 A *Ageneiosus brevifilis* (Cuvier & Valenciennes).
 A *Hypophthalmus edentatus* Spix.
 * *Pygidium borellii* Boulenger.
 / S *Pygidium brasiliensis* (Reinhardt).
 / *Pygidium cordovens* Weyenberg.
 ** *Homodæatus anisitsi* Eigenman & Ward.
 C *Plecostomus johnei* Steindachner.
 A *Plecostomus plecostomus* (Linnæus).
 S *Plecostomus commersoni* (Valenciennes).
 S *Plecostomus vaillanti* Steindachner.
 * *Plecostomus borellii* Boulenger.
Plecostomus robinii Cuvier & Valenciennes.

- CS *Plecostomus wuchereri* Günther.
 A *Hemiancistrus vittatus* (Steindachner).
 A *Cochliodon cochliodon* Kner.
 * *Pterygoplichthys multiradiatus* Bloch.
 * *Pterygoplichthys anisitsi* Eigenmann & Kennedy.
 * *Pterygoplichthys juvenis* Eigenmann & Kennedy.
 * *Pterygoplichthys gigas* Boulenger.
 A *Pseudancistrus barbatus* Cuvier & Valenciennes.
 A *Xenocara gymnorhynchus* Kner.
 A *Ancistrus cirrhosus* Valenciennes.
 A *Ancistrus cirrhosus dubius* Eigenmann & Eigenmann.
 A *Ancistrus hoplogenys* (Günther).
 * *Oxyropsis inexpectatum* Holmberg.
 * *Otocinclus vittatus* Regan.
 A *Hemiodontichthys acipenserinus* (Kner).
 a* *Sturisoma robusta* Regan.
 * *Sturisoma barbata* Kner.
 * *Loricaria parva* Boulenger.
 % *Loricaria catamarcensis* Berg.
 A *Loricaria phoxocephala* Eigenmann & Eigenmann.
 * *Loricaria maculata* Bloch.
 A *Loricaria typus* Bleeker.
 * *Loricaria labialis* Boulenger.
 | *Loricaria anus* Valenciennes.
 A *Loricaria cataphracta* Linnæus.
 A *Loricaria carinata* Castlenau.
 * *Loricaria apeltogaster* Boulenger.
 * *Loricaria macrodon* Kner.
 * *Loricaria laticeps* Regan.
 * *Loricaria platycephala* Kner.
 a* *Corydoras microps* Eigenmann & Kennedy.
 * *Corydoras paleatus* Jenyns.
 * *Corydoras aurofrenatus* Eigenmann & Kennedy.
 * *Corydoras australe* Eigenmann & Ward.
 AC *Callichthys callichthys* Linnæus.
 * *Callichthys callichthys asper* Quoy & Gaimard.
 * *Callichthys callichthys hemiphractus* Hensel.

- * *Hoplosternum pectoralis* (Boulenger).
- A *Hoplosternum littorale* (Hancock).
- ACS *Hoplias malabaricus* (Bloch).
- AC *Hoplerythrinus uniteniatus* (Spix).
- | A *Pyrrhulina australe* Eigenmann & Kennedy.
- | A *Pyrrhulina brevis* Steindachner.
- | A *Psectrogaster curviventris* Eigenmann & Kennedy.
- A *Curimatella alburnus* (Müller & Troschel).
- * *Curimatella alburnus australe* Eigenmann & Kennedy.
- A *Curimatus spilurus* Günther.
- * *Curimatus gilli* Eigenmann & Kennedy.
- A *Curimatus nasus* Steindachner.
- * *Curimatus nigrotænia* Boulenger.
- * *Curimatus elegans nitens* Holmberg.
- A *Curimatus bimaculatus* Steindachner.
- A *Curimatus rutiloides* Kner.
- C *Curimatus gilberti* Quoy & Gaimard.
- A *Anodus latior* Spix.
- aS *Prochilodus argenteus* Agassiz.
- C *Prochilodus scrofa* Steindachner.
- | *Prochilodus lineatus* (Valenciennes).
- * *Anisitsia othonops* Eigenmann & Kennedy.
- A *Hemiodus unimaculatus* Bloch.
- * *Hemiodus semitæniatus* Kner.
- A *Hemiodus microlepis* Kner.
- A *Parodon suborbitalis* Cuvier & Valenciennes.
- * *Parodon gestri* Boulenger.
- * *Parodon tortuosus* Eigenmann & Norris.
- * *Parodon paraguayensis* Eigenmann.
- a* *Nannostomus lateralis* (Boulenger).
- S *Schizodon isognathus* Kner.
- * *Schizodon borellii* (Boulenger).
- A *Schizodon fasciatus* Spix.
- A *Lahilliella nasutus* Kner.
- A *Leporinus striatus* Kner.
- AC *Leporinus friderici* Bloch.
- A *Leporinus obtusidens* Valenciennes.

- A *Leporinus trifasciatus* Steindachner.
 A *Leporinus eques* Steindachner.
 A *Leporinus affinis* Günther.
 A *Leporinus hypselonotus* Günther.
 AC *Leporinus conirostris* Steindachner.
 A *Leporinus fasciatus* Agassiz.
 AC *Characidium fasciatum* Reinhardt.
 Characidium lateralis (Boulenger).
 * *Characidium borelli* (Boulenger).
 a* *Odontostilbe paraguayensis* Eigenmann & Kennedy.
 * *Odontostilbe trementinæ* Eigenmann & Kennedy.
 * *Cheirodon ribeiroi* Eigenmann.
 a* *Cheirodon interruptus* (Jenyns).
 * *Cheirodon calliurus* Boulenger.
 A *Cheirodon insignis* Steindachner.
 A *Cheirodon nattereri* Steindachner.
 A *Holosthetes peqeira* (Steindachner).
 a* *Aphyocharax dentatus* Eigenmann & Kennedy.
 * *Aphyocharax stramineus* Eigenmann.
 A *Aphyocharax alburnus* Günther.
 * *Aphiocarax rathbuni* Eigenmann.
 A *Aphyocharax anisitsi* Eigenmann & Kennedy.
 AS *Hemigrammus gracilis* (Reinhardt).
 ? *Hemigrammus callistus* (Boulenger).
 * *Hemigrammus anisitsi* Eigenmann.
 Hemigrammus lütkeni (Boulenger).¹
 * *Hemigrammus tridens* Eigenmann.
 * *Hemigrammus ulreyi* (Boulenger).
 * *Hemigrammus kennedyi* Eigenmann.
 A *Tetragonopterus argenteus* Cuvier.
 A *Ctenobrycon hauxwellianus* Cope.
 * *Gymnocorymbus ternetzi* Boulenger.
 * *Astyanax alleni* Eigenmann & McAtee.
 ACS *Astyanax fasciatus* (Cuvier).
 * *Astyanax pellegrini* Eigenmann.
 A *Astyanax abramis* (Jenyns).

¹ Paraguay and southeastern Brazil.

- ACS *Astyanax bimaculatus* Linnæus.
 * *Astyanax lineatus* Holmberg.
 ** *Astyanacinus moorii* (Boulenger).
 A *Mænkhausia agassizii* Steindachner.
 A *Mænkhausia dichrourus* Kner.
 A *Mænkhausia lepidurus* (Kner).
 * *Bryconamericus mænkhausii* Eigenmann & Kennedy.
 A* *Bryconamericus exodon* Eigenmann.
 | *Bryconamericus iheringii* Boulenger.
 AC *Fowlerina paraguayensis* Eigenmann.
 a *Brachyhalcinus retrospina* (Boulenger).¹
 * *Brycon hildarii* (Cuvier & Valenciennes).
 * *Brycon microlepis* Perugia.
 | *Brycon orbignianus* (Cuvier & Valenciennes).
 A *Cretochanes melanurus* (Bloch).
 A *Thoracocharax stellatus* Kner.
 * *Chalcinus paranensis* Günther.
 A *Chalcinus angulatus* Spix.
 A *Chalcinus angulatus curtus* Garman.
 AS *Pygocentrus piraya* Cuvier.
 A *Pygocentrus nattereri* (Kner).
 A *Pygopristis serrulatus* Cuvier & Valenciennes.
 AS *Serrasalmo marginatus* Valenciennes.
 A *Serrasalmo spilopleura* Kner.
 A *Serrasalmo gymnogenys* Günther.
 A *Serrasalmo humeralis* Cuvier & Valenciennes.
 A *Serrasalmo rhombus* Linnæus.
 * *Metynnis mola* Eigenmann & Kennedy.
 A *Metynnis hypsauchen* Müller & Troschel.
 A *Myleus asterias* Müller & Troschel.
 A *Piaractus brachipomus* (Cuvier).
 A *Mylossoma aureus* (Agassiz).
 A *Mylossoma albiscopus* Cope.
 * *Myleus levis* Eigenmann & McAtee.
 A *Charax gibbosus* Bloch.
 * *Charax squamosus* Eigenmann & Kennedy.

¹ This species at Santa Cruz and Paraguay.

- * *Characinus calliurus* Eigenmann.
- A *Ræstes molossus* Kner.
- A *Ræboides microlepis* Reinhardt.
- | *Ræboides bonariensis* Steindachner.
- * *Ræboides prognathus* Boulenger.
- A *Cynopotamus humeralis* (Valenciennes).
- Cynopotamus magdalenæ* Steindachner.¹
- Cynopotamus kneri* Steindachner.
- A *Salminus brevidens* Cuvier.
- A *Acestrorhynchus ferox* (Bloch).
- C *Acestrorhamphus hepsetus* (Cuvier).
- A *Raphiodon vulpinus* Spix.
- A *Sternarchus albifrons* Linnæus.
- A *Rhamphichthys reinhardtii* Kaup.
- A *Rhamphichthys marmoratus* Castelnau.
- A *Hypopomus brevirostris* Steindachner.
- AS *Sternopygus macrurus* Bloch & Schneider.
- AS *Eigenmannia virescens* (Valenciennes).
- AS *Gymnotus carapo* Linnæus.
- AC *Synbranchus marmoratus* Bloch.
- A *Stolephorus olidus* Günther.
- A *Rivulus punctatus* Boulenger.
- A *Girardinus caudomaculatus* Hensel.
- Cnesterodon decemmaculatus* Jenyns.
- * *Fundulus paraguayensis* Eigenmann & Kennedy.
- Fundulus balzanii* Perugia.
- ** *Ilyodon paraguayense* Eigenmann.
- A *Potamorhaphis guianensis* (Schomburgk).
- A *Tylosurus amazonicus* (Steindachner).
- | *Pachyurus bonariensis* Steindachner.
- A *Pachyurus schomburgkii* Günther.
- a* *Plagioscion ternetzi* Boulenger.
- a* *Chætobranchopsis australe* Eigenmann & Ward.
- A *Astronotus ocellatus* (Agassiz).
- A *Æquidens tetramerus* (Heckel).
- Æquidens portalagrensis* (Heckel).

¹ Paraguay and Magdalena. This species is recorded on the doubtful authority of Perugia.

- A. Equidens dorsigera* (Heckel).
 * *Æquidens paraguayensis* Eigenmann & Kennedy.
A. Æquidens vittata (Heckel).
A. Cichlasoma binaculata (Linnæus).
 * *Heterogramma corumbæ* Eigenmann & Ward.
 * *Heterogramma borellii* Regan.
 * *Heterogramma trifasciatum* Eigenmann & Kennedy.
A. Mesonauta festivus (Heckel).
A. Crenicichla lepidota Heckel.
A. Crenicichla adspersa Heckel.
A. Crenicichla vittata Heckel.
A. Crenicichla saxatilis (Linnæus).
 / *Batrachops semifasciata* Heckel.
 * *Batrachops ocellata* Perugia.
 * *Satanoperca pappaterra* Heckel.
 * *Geophagus balzanii* Perugia.
 Geophagus ejurupari Heckel
 / *Achirus jenynsii* (Günther).

It is seen that over 53 per cent. of the total are species that are also found in the Amazon basin; 36 per cent. are peculiar, and over 15 per cent. are common to the Paraguay and eastern Brazil. The proportions common to the Amazon and the Paraguay are not the same for all genera. All of the species of *Sternopygidae* (7), *Schizodon* (4), *Leporinus* (7) *Serrasalmonineæ* (8), and five out of seven *Mylinæ* found in the Paraguay basin are also found in the Amazon. A comparison of the number of species common to the Paraguay and to the Amazon and to the Paraguay and eastern Brazil leaves no doubt as to the origin of the fauna of the Paraguay. It came from the Amazon.

THE PARANA AND LA PLATA.

The fauna of the Parana and La Plata, as far as known, is quite different from that of the Paraguay. Much of this difference is probably apparent rather than real. The Parana is divisible into two regions—that above the falls with its tributaries belonging to the Brazilian plateau has been mentioned before. Its fauna is very imperfectly known from collections made by Natterer at Irisanga and incidentally described by Kner, and from a collection made by Von Ihering in São Paulo and described by Eigenmann & Norris.

SPECIES OF THE UPPER PARANA, LOWER PARANA, LA PLATA AND RIO GRANDE DO SUL.

	S. E. Brazil.	Upper Parana.	Lower Parana, La Plata.	Rio Grande do Sul.
<i>Exomegas macrostomus</i> (Burmeister).			×	
<i>Galeus vulgaris</i> Müller & Henle.			×	
<i>Raja microps</i> Günther.			×	
<i>R. platana</i> Günther.			×	
<i>Myliobatis aquila</i> (Linnæus).			×	
<i>Potamotrygon brachyurus</i> Günther.			×	
<i>P. hystrix</i> (Müller & Henle).			×	
<i>Bunocephalus iheringii</i> Boulenger.				×
<i>Genidens genidens</i> (Cuvier & Valenciennes).		×	×	×
<i>Netuma upsulonophorus</i> (Eigenmann & Eigenmann).				×
<i>N. barbatus</i> (Lacépède.)			×	×
<i>Arius agassizii</i> Eigenmann & Eigenmann.				×
<i>Luciopimelodus pati</i> (Valenciennes).			×	
<i>L. platanus</i> (Günther).		×	×	
<i>Pseudopimelodus cottoides</i> Boulenger.				
<i>Ps. zungaro</i> (Humboldt).	×	×	×	
<i>Rhamdia quelen</i> (Quoy & Gaimard).			×	×
<i>R. sapo</i> (Valenciennes).			×	×
<i>R. hilarii</i> (Cuvier & Valenciennes).	×		×	×
<i>Rhamdella eriarcha</i> Eigenmann & Eigenmann.				×
<i>R. jenynsii</i> (Günther).		×	×	
<i>R. straminea</i> Cope.				×
<i>Heptapterus mustelinus</i> (Valenciennes).			×	×
<i>Acentronichthys collettii</i> (Steindachner).			×	
<i>Imparfinis piperatus</i> Eigenmann & Norris.		×		
<i>Nannoglanis bifasciatus</i> Eigenmann & Norris.		×		
<i>Pimelodus clarias</i> (Bloch).	×	×	×	×
<i>P. valenciennesi</i> Kröyer.	×		×	×
<i>P. fur</i> Reinhardt.	×	×		
<i>Bergiaria platana</i> (Steindachner).			×	
<i>Iheringichthys labrosus</i> (Kröyer).		×	×	
<i>Pimelodella lateristriga</i> (Müller & Troschel).	×			×
<i>P. gracilis</i> (Valenciennes).			×	?
<i>P. eigenmanni</i> Meek.		×		
<i>Paulicea jahu</i> von Ihering.		×		
<i>Pseudoplatystoma coruscans</i> (Agassiz).	×		×	
<i>Sorubim lima</i> (Bloch & Schneider).			×	
<i>Doras granulosus</i> Valenciennes.			×	
<i>Oxydoras d'orbigny</i> Kröyer.			×	
<i>Ageneiosus valenciennesi</i> Bleeker.	×		×	
<i>Pygidium brasiliensis</i> (Lütken).	×			×
<i>P. borelli</i> (Boulenger).			×	
<i>P. schmidtii</i> (Berg.).			×	
<i>P. minutus</i> (Boulenger).				×
<i>P. spegazzinii</i> Berg.			×	
<i>Cetopsis goboides</i> Kner.		×		
<i>Henonemus maculatus</i> (Steindachner).			×	
<i>Callichthys callichthys</i> (Linnæus).	×		×	×
<i>Hoplosternum littorale</i> (Hancock).			×	
<i>Corydoras paleatus</i> (Jenyns).			×	×
<i>Plecostomus plecostomus</i> (Linnæus).			×	
<i>P. regani</i> von Ihering.		×		

SPECIES OF THE UPPER PARANA, LOWER PARANA, LA PLATA AND RIO GRANDE DO SUL.

	S. E. Brazil.	Upper Parana.	Lower Parana, La Plata.	Rio Grande do Sul.
<i>Plecostomus commersoni</i> (Cuvier & Valenciennes).	×		×	×
<i>P. tretensis</i> von Ihering.		×		
<i>P. garmani</i> Regan.	×			×
<i>P. hermanni</i> von Ihering.		×		
<i>P. robini</i> Cuvier & Valenciennes.			×	
<i>P. paulinus</i> von Ihering.		×		
<i>Ancistris cirrhosus</i> Valenciennes.				×
<i>Otocinclus flexilis</i> Cope.				×
<i>Microlepidogaster nigricauda</i> (Boulenger.)				×
<i>M. perforatus</i> Eigenmann & Eigenmann.				×
<i>Loricaria cadeæ</i> Hensel.				×
<i>L. strigilata</i> Hensel.				×
<i>L. microlepidogaster</i> Regan.				×
<i>L. latirostris</i> Boulenger.		×		
<i>L. spixii</i> Steindachner.	×			
<i>L. anus</i> Cuvier & Valenciennes.			×	×
<i>L. macrops</i> Regan.			×	
<i>L. vetula</i> Cuvier & Valenciennes.		×	×	
<i>Hoplias malabaricus</i> (Bloch).	×	×	×	×
<i>Hoplerethrinus uniteniatus</i> (Spix).	×		×	
<i>Curimatus spiluropsis</i> Eigenmann & Eigenmann.		×		
<i>C. gilberti</i> Quoy & Gaimard.				×
<i>C. gilberti brevipinnis</i> Eigenmann & Eigenmann.		×	×	
<i>C. platana</i> Günther.			×	
<i>Prochilodus reticulatus</i> Valenciennes.		×		
<i>P. platensis</i> Holmberg.			×	
<i>P. scrofa</i> Steindachner.	×	×		
<i>P. lineatus</i> (Valenciennes).			×	×
<i>P. nigricans</i> Agassiz.			×	
<i>Parodon piracicabæ</i> Eigenmann.		×		
<i>P. affinis</i> Steindachner.			×	
<i>P. tortuosus</i> Eigenmann & Norris.		×		
<i>Nannostomus lateralis</i> Boulenger.			×	
<i>Anostomus vittatus</i> Cuvier & Valenciennes.			×	
<i>A. isognathus</i> Kner.	×		×	×
<i>A. platæ</i> Garman.			×	
<i>A. nasutus</i> Kner.		×	×	
<i>Characidium fasciatum</i> Reinhardt.				×
<i>Characidium tenue</i> Cope.	×	×		
<i>Leporinus friderici</i> Bloch.	×		×	
<i>L. obtusidens</i> Valenciennes.			×	×
<i>L. copelandi</i> Steindachner.	×	×		
<i>L. affinis</i> Günther.			×	
<i>L. solarii</i> Holmberg.			×	
<i>Cheirodon interruptus</i> (Jenyns).			×	
<i>Cheirodon monodon</i> (Cope).				×
<i>Aphyocharax alburnus</i> Günther.			×	
<i>Tetragonopterus chalceus</i> (Agassiz).			×	
<i>Hemigrammus lütkeni</i> Boulenger.	×			×
<i>Astyanax erythropterus</i> (Holmberg).			×	
<i>Astyanax correntinus</i> (Holmberg).		×		
<i>Astyanax abramis</i> (Jenyns).			×	

SPECIES OF THE UPPER PARANA, LOWER PARANA, LA PLATA AND RIO GRANDE DO SUL.

	S. E. Brazil.	Upper Parana.	Lower Parana, La Plata.	Rio Grande do Sul.
<i>Astyanax bimaculatus</i> (Linnæus).			×	×
<i>A. alburnus</i> (Hensel).				×
<i>A. laticeps</i> (Cope).				×
<i>A. eigenmanniorum</i> (Cope).				×
<i>A. cordovæ</i> (Günther).			×	
<i>A. fasciatus</i> (Cuvier).	×	×	×	×
<i>A. rubripictus</i> (Berg).				
<i>Bryconamericus iheringii</i> (Boulenger).				×
<i>Markiana nigripinnis</i> (Perugia).			×	
<i>Brycon lineatus</i> Steindachner.			×	
<i>B. nattereri</i> Günther.		×		
<i>B. orbignyanus</i> Cuvier & Valenciennes.			×	
<i>Chalcinus paranensis</i> Günther.			×	
<i>Pseudocorynopoma doriæ</i> Perugia.			×	?
<i>Piabucus melanostoma</i> Holmberg.			×	
<i>Diapoma speculiferus</i> Cope.				×
<i>Pygocentrus nattereri</i> (Kner).			×	
<i>Serrasalmo marginatus</i> (Valenciennes).	×		×	
<i>Piaractus brachipomus</i> (Cuvier).			×	
<i>Metynnus maculatus</i> (Kner).			×	
<i>Myleus tiete</i> (Eigenmann & Norris).		×		
<i>Colossoma mitrei</i> (Berg).			×	
<i>C. orbignyanus</i> (Cuvier & Valenciennes).			×	
<i>Mylossoma aureus</i> (Spix).			×	
<i>Asiphonichthys stenopterus</i> Cope.				×
<i>Ræboides bonariensis</i> Steindachner.			×	
<i>Cynopotamus argenteus</i> Valenciennes.			×	
<i>C. humeralis</i> Valenciennes.			×	
<i>C. knerii</i> Steindachner.		×	×	
<i>Salminus maxillosus</i> Cuvier & Valenciennes.			×	
<i>S. brevidens</i> Cuvier.	×		×	×
<i>S. hilarii</i> (Cuvier & Valenciennes).	×		×	
<i>Catabasis acuminatus</i> (Eigenmann & Norris).		×		
<i>Acestrorhamphus brachycephalus</i> Cope.				×
<i>A. jenynsii</i> Günther.	×		×	×
<i>A. oligolepis</i> (Steindachner).			×	
<i>A. hepsetus</i> (Cuvier).	×		×	
<i>Raphiodon vulpinus</i> Spix.			×	
<i>Sternarchus albifrons</i> (Linnæus).		×	×	
<i>Rhamphichthys marmoratus</i> Castelnau.			×	
<i>Eigenmannia virescens</i> (Valenciennes).	×	×	×	×
<i>Gymnotus carapus</i> Linnæus.	×		×	×
<i>Synbranchus marmoratus</i> Bloch.	×		×	×
<i>Stolephorus clupeoides</i> (Swainson).				×
<i>S. olidus</i> Günther.			×	
<i>Ilisha flavipinnis</i> (Valenciennes).			×	
<i>Cynolebias bellottii</i> Steindachner.			×	
<i>C. maculatus</i> Steindachner.			×	
<i>C. elongatus</i> Steindachner.			×	
<i>C. robustus</i> Günther.			×	
<i>Jenynsia lineata</i> (Jenyns).			×	×
<i>Girardinus januarius</i> Hensel.	×			×

SPECIES OF THE UPPER PARANA, LOWER PARANA, LA PLATA AND RIO GRANDE DO SUL.

	S. E. Brazil.	Upper Parana.	Lower Parana, La Plata.	Rio Grande do Sul.
<i>Girardinus caudimaculatus</i> Hensel.				×
<i>Cnesterodon decemmaculatus</i> (Jenyns).			×	×
<i>Mugil platanus</i> Günther.			×	.
<i>Atherinopsis regia</i> (Humboldt).			?	
<i>Pachyurus bonariensis</i> Steindachner.			×	×
<i>Cichla niederleini</i> (Holmberg).			×	
<i>C. chacoensis</i> (Holmberg).			×	
<i>Æquidens tetramerus</i> (Heckel).				×
<i>Æ. centralis</i> (Holmberg).			×	
<i>Æ. portalegrensis</i> (Hensel).				×
<i>Æ. minuta</i> (Hensel).				×
<i>Cichlasoma facetum</i> Jenyns.	×	×	×	×
<i>C. jenynsii</i> Steindachner.			×	
<i>C. autochthon</i> Günther.	×	×	×	×
<i>C. lepidota</i> Heckel.			×	×
<i>Batrachops semifasciata</i> Heckel.			×	
<i>B. lacustris</i> Castelnau.	×	×		×
<i>Geophagus brasiliensis</i> (Quoy & Gaimard).	×	×	×	×
<i>G. brachyurus</i> Cope.			×	×
<i>G. gymnogenys</i> Hensel.	×		×	×
<i>Guavina guavina</i> Cuvier & Valenciennes.				×
<i>Achirus lineatus</i> (Linnæus).			×	
<i>A. jenynsii</i> (Günther).			×	
<i>Symphurus plagusia</i> Bloch & Schneider.			×	

The Parana below the falls to Buenos Aires has been made known by Valenciennes, Günther, Perugia, Berg and La Hille.

At this place may also be considered the fauna of that part of Rio Grande do Sul draining eastward. The fauna of this area is more distinct from that of the La Plata than the Paraguayan is from the Amazonian, only about 46 per cent. of its fishes being identical with species occurring in the La Plata. Its affinities are, however, with the La Plata rather than with the coastwise streams north of Rio de Janeiro, only about 30 per cent. of its fauna being identical with that of the northern rivers.

There are known in the region under consideration 170 species which may safely be considered to be less than one-half of the total number of species inhabiting it. Of these, 64 species are also found in the Paraguay, 50, or a little over 29 per cent. are of wide distribution, having been taken in the Amazon. Thirty-four species are common to this region and southeast Brazil. Of these, 15 are included in the 49 recorded from the Amazon, leaving 19 common to the two regions. This number gives us a hint as to the extent to which southeast Brazil has contributed to the La Plata, or the La Plata to the latter.

Of the 31 species recorded from above the falls of the Parana 16 are also found below it.

There is no indication that the fauna of the Rio San Francisco, or the Alta Parana, which is geographically nearer to southeast Brazil, is more like the fauna of the latter region than is the La Plata fauna, for we have :

Number of species in the Upper Parana and Southeastern Brazil	3
Number of species in the Lower Parana and Southeastern Brazil	4
Number of species in the Alta and Baja Parana and Southeastern Brazil.....	4
Number of species in the Rio Grande do Sul and Southeastern Brazil.....	8
Number of species in the Rio Grande do Sul, La Plata and Southeastern Brazil....	10
Number of species in all four localities.....	5

33

VII. THE ORIGIN OF THE PACIFIC SLOPE FAUNA.

There are four distinct faunas on the Pacific slope of America between Cape Horn and the tropic of Cancer. One of these is of common origin with that on the Atlantic slope, one is autochthonous and the other two are derivative from the Atlantic slope faunas opposed to them.

1. The fauna of southern Chili is essentially like that of Patagonia, and inasmuch as it is largely made up of marine forms entering fresh water, and fresh-water forms entering the ocean, it seems very probable that the species migrated from river to river along the coast from Patagonia to Chili or from Chili to Patagonia.

2. At the other extreme in the Rio Mezquital of the Transition Region and the Yaqui just to the north of it there is a fauna essentially like that of the Rio Grande east of them. As Meek has pointed out, the Yaqui and Mezquital have captured tributaries of the Rio Grande together with the fishes in them, and the migration of Atlantic slope northern forms to the Pacific slope has been a passive one.

Thus, types which in America north of Mexico have not succeeded in reaching the Pacific slope, have, within the Tropics, crossed the divide. *Etheostoma pottsi* is the only representative out of over 50 North American species of *Percidæ* that has crossed the divide and has done it in this way. *Ameiurus dugesi* and *pricei* and *Istlarius balsanus* are the only North American catfishes which have crossed the divide. The Rio Mezquital within the tropics contains *Pantosteus plebeius*, *Hybognathus episcopus*, *Leuciscus nigrescens*, *Notropis ornatus*, all species extending northward

and found in the north only on the Atlantic slope. It also contains *Ameiurus pricei*, one of the three Pacific slope catfishes and *Etheostoma pottsi*, the only Pacific slope Percoid.

3. The third fauna is the Mexican of the Rio de Santiago. This is undoubtedly the relict of an old fauna reënforced by a few immigrants from the north. It is here not a question of the origin of the fauna from an eastern one, but of an autochthonous development that has, on its part, contributed elements to the surrounding rivers. It passively contributed to the Atlantic slope fauna by having one of its small rivers captured by the Rio Panuco.

4. Of more particular interest is the origin of the fauna of western Peru and Ecuador and that of western Central America. Not enough is known of the fauna of the western part of Central America to attempt an explanation of its origin.

To quote the words of Gilbert and Sparks, who considered the marine fishes on opposite sides of Panama (The Fishes of Panama Bay, 205, 1904): "The ichthyological evidence is overwhelmingly in favor of the existence of a former open communication between the two oceans, which must have been closed at a period sufficiently remote from the present to have permitted the specific differentiation of a very large majority of the forms involved." They found that "Of the 82 families of fishes represented at Panama all but 3 (*Cerdalidæ*, *Cirhitidæ* and *Nematestiidæ*) occur also on the Atlantic side of Central America; "while of the 218 genera of our Panama list, no fewer than 170 are common to both oceans." * "Fifty-four out of a total of 374 or 14.4 per cent. of the Pacific coast species are identical with Atlantic coast species."

There seems to me to be just as conclusive evidence that the present fresh-water fauna of the Pacific slope developed *after* the obliteration of the waterway connecting the two oceans, if this waterway occupied the Amazon valley, and that the Atlantic slope streams of the Cordilleras became colonized by their present fauna after the obliteration of this waterway.

The similarity between the Amazonian and Pacific slope faunas of South America is much greater than the similarity between the Atlantic and Pacific slope faunas of North America. This similarity leaves the community of origin of the two faunas unquestioned. Is a continuous coast line between the two slopes necessary to account for the similarity? Such



Range of the most widely distributed genus of characins, *Astyanax*. (It occurs in Trinidad.)



Range of the characid genus *Brycon*.



Range of the most widely distributed catfish genus *Rhamdia*. (In Trinidad.)



Range of Synbranchid eel in America and Asia. One of the two South American genera that have reached Cuba. (In Trinidad.) One species.

TO ILLUSTRATE THE ORIGIN OF THE PACIFIC SLOPE FAUNA.



Range of the gymnotid eel, *Eigenmannia*.
Five species.



Range of the characid genus, *Hoplias*.
Three species. (In Trinidad.)



Range of the slender mailed-catfish, *Loricaria*.



Range of the Cichlid, *Aequidens*. (In Trinidad.) Probably also in the San Francisco (white).

TO ILLUSTRATE THE ORIGIN OF THE PACIFIC SLOPE FAUNA.



Range of the characid genus, *Prochilodus*.



Range of the characid genus *Curimatus*.
(In Trinidad.)



Range of the minute catfishes of the genus
Pimelodella.



Range of the mailed-catfish genus, *Pleco-*
stomus. (In Trinidad.)

TO ILLUSTRATE THE ORIGIN OF THE PACIFIC SLOPE FAUNA.



Known distribution of the Gymnotid genus *Sternopygus* (three species).



Known distribution of the genera *Gasteropelecus* and *Thoracocharax*, two aberrant characins.



Known range of the mailed-catfish genus *Hemiancistrus*.



Known distribution of the mailed-catfish genus *Sturisoma*.

TO ILLUSTRATE THE ORIGIN OF THE PACIFIC SLOPE FAUNA.



Known range of the Cetopsinae.

Known range of the characid genus Hembrycon.¹ (In Trinidad.)

Range of the characid genus Luciocharax.



Known distribution of the characid genus Cheirodon. The species are small, many of them probably unknown. The only tropical genus represented in Chili.

TO ILLUSTRATE THE ORIGIN OF THE PACIFIC SLOPE FAUNA.

¹ It is probable that this is a nascent genus arising in different places from different species of the genus *Astyanax* or *Bryconamericus*.



Distribution of the presumably old mountain catfish, *Pygidium*.



Distribution of the catfish *Cyclopium* of the high Andes.



Distribution of the mailed-catfish *Chaetostomus* of the Andes. Pacific side of Panama.



Distribution of the Andean characin, *Crea-grutus*.

TO ILLUSTRATE THE ORIGIN OF THE PACIFIC SLOPE FAUNA.

a coast line is not needed, because, first, some of the species of the Pacific slope are mountain forms, some of them living on both slopes. If such a genus as *Pygidium* has been able to establish itself from stream to stream along the Andes from Guiana to Patagonia, it needs no continuous waterway to explain its presence on both slopes. The same for more limited reasons applies to *Chætostomus* and *Arges*. Second, a watershed of moderate height is not necessarily a barrier to the migration of fresh-water fishes and several species have evidently succeeded in recent times in crossing the divide in the northwest corner of the continent in one direction or the other, inasmuch as over 27 per cent. of the entire Pacific fauna is also found on the Atlantic, a consensus which is significant and conclusive.

Nearly all the genera found on both slopes, the exceptions to be considered presently, are genera of very wide distribution on the Atlantic slope, reaching the Magdalena or the Isthmus of Panama.

Only four genera are confined to the Pacific slope: *Paracetopsis*, *Lebiasina*, *Pseudochalceus* and *Saccodon*. The other genera represented on the Pacific slope are distributed as follows:

1. *Rhamdia*. Magdalena to the Rio de La Plata and Mexico; Lake Titicaca, San Francisco and Minas Geraes, p. 354.
2. *Pimelodella*. Rio Chagres at Panama to La Plata; Para to Canelos, p. 356.
3. *Paracetopsis*. Canelos to Para; Irisanga, p. 358.
4. *Pygidium*. Andes from Venezuela to Patagonia; French Guiana and southeastern Brazil, central Argentina, p. 359.
5. *Plecostomus*. Magdalena to La Plata and Cordova; San Francisco and southeastern Brazil; Para to Ambyacu, p. 356.
6. *Hemiancistrus*. Eastern Ecuador to Paraguay, Para and Guiana, p. 357.
7. *Chætostomus*. Eastern and western slopes from Peru to Panama and Venezuela, p. 359.
8. *Loricaria*. Rio Chagres and Magdalena to Para and Buenos Aires; Calderon and Canelos, Xeberos, p. 355.
9. *Sturisoma*.¹ Magdalena to Paraguay; Rio Jurua, Manacapuru; Xeberos, p. 357.
10. *Arges*. Andes of Peru, Ecuador, Colombia and Venezuela.
11. *Cyclopium*. Andes, north of Canelos, p. 359.

¹ This is probably a genus of diverse origin.

12. *Hoplias*. Chagres and Magdalena to Trinidad, La Plata, Para and Huallaga, p. 355.
13. *Curimatus*. Magdalena to Trinidad and La Plata; Para to Huallaga and Canelos, p. 356.
14. *Prochilodus*. Magdalena to the La Plata and Peru, p. 356.
15. *Luciocharax*. Magdalena, p. 358.
16. *Astyanax*. Magdalena to the United States, Trinidad and La Plata and Peru, p. 354.
17. *Hemibrycon*. Peru, Ecuador and Trinidad, p. 358.
18. *Cheirodon*. Magdalena south to San Francisco, La Plata and Chili, p. 358.
19. *Gasteropelecus*.¹ Pacific slope of Panama, Essequibo, Amazons and southeast Brazil, p. 357.
20. *Brycon*. Magdalena to Guatemala and La Plata, San Francisco, Ambyiacu, p. 354.
21. *Creagrutus*. Magdalena to Rio das Velhas. Few species widely separated, an old genus?, p. 359.
22. *Eigenmannia*. Magdalena to Rio San Francisco and La Plata, Para to Pebas, Parana, p. 355.
23. *Sternopygus*. Magdalena to Paraguay and Rio Canelos, San Francisco, p. 357.
24. *Synbranchus*. Magdalena to Rio Motagua, Trinidad, La Plata, p. 354.
25. *Æquidens*. Magdalena to La Plata, p. 355.

All of these show their ability for adaptation and colonization by their wide distribution. The probable route of transit is up the Atrato and down the San Juan, or up the Chagres and down the Pacific side of Panama.

Conspicuous exceptions are the genera *Cheirodon*, *Hemiancistrus* and the *Cetopsinæ*, a group which, until the present, has been considered a single genus. I am entirely at a loss to account for the presence of *Cheirodon* in Chili and no interoceanic channel in the region of the Amazon would help us to account for its presence in Chili or in Patagonia.²

¹ Inclusive of the genus *Thoracocharax*.

² The *Cetopsinæ* are found on the Atlantic slope throughout the length of the Amazons to the Huallaga in Peru and up the Napo to the mountain streams about Canelos, Ecuador, and are also found directly across the Andes from Canelos in the Guayaquil. The inference is obvious. *Paracetopsis* has succeeded in getting across the Andes of Ecuador at a sufficiently long time ago to enable the Guayaquil form to become generically and specifically distinct. *Hemiancistrus* has a similar distribution, being also found on the western slope of Panama.

Of the genera peculiar to the western slope *Protisius* and *Gastropterus* are of marine origin not related to Atlantic slope forms. They are found at high altitudes and are remnants of early colonists from the sea. *Lebiasina* is a genus of *Characidæ* very closely related to *Piabucina* of wide distribution on the Atlantic slope. *Saccodon* is related to *Paradon*, distributed from the La Plata to Colombia and to *Hemiodus* from the Orinoco to the San Francisco, the Peruvian Amazon and the upper courses of the Paraguay. From one or the other it is probably an offshoot, sufficiently remote in time to be generically different. All of the genera are very probably among the oldest on the continent.

It is seen that the present distribution of the fresh-water fishes does not require an interoceanic waterway for its explanation. Does the present distribution of fresh-water fishes offer any objection to such an interoceanic connection in recent times? Two or three things are opposed to this supposition. One is the paucity of the Pacific fauna in general, and the second the absence of many Atlantic slope families, especially the *Lepidosirenidæ*, *Aspredinidæ*, *Hypophthalmidæ*, *Callichthyidæ*, *Electrophoridæ*, *Osteoglossidæ*, *Arapamidæ* and many dominant Atlantic slope genera, all of them lowland forms, and the third the absence of all tropical American forms, except *Pygidium* from Lake Titicaca.

If the reigning fauna had been present on the eastern slopes of the Andes even in outline at a time of the interoceanic canal, a very much larger per cent. of the Atlantic slope forms ought to be found on the Pacific slope, unless the Pacific slope streams were uninhabitable, or, unless the fauna became extinct, after the separation of the oceans and the streams were repopulated by new emigrants from the east.

The meagreness of the Pacific slope fauna is probably in great part due to the small rivers and precarious water supply. It can scarcely be supposed that a fauna became extinct to be replaced by a similar one. It is quite certain that its present fauna has been derived from forms whose wide distribution shows them to be especially fit to cross existing barriers and which were probably the very first to reach the Atlantic slope of the Andes. All of them are old genera, among the oldest on the continent.

If the present fauna had been in existence along the Andes at the time Lake Titicaca was much lower, it ought to have received a fair sprinkling at least of the fresh-water fauna, but it contains little but marine types.

All of these considerations lead me to conclude that the present fauna

migrated to the Pacific slope subsequent to the formation of the Andes and after the obliteration of the interoceanic sea, if such existed in the place supposed, and long after the colonization of the coast streams of Minas, etc.

If the supposition be established, that few, if any, ancient Atlantic slope forms reached the Andes in time to cross the divide by going from stream to stream along oceanic channels, it indicates very strongly that the fresh-water species were unable to bridge the gap between the ancient land masses, Archiplata and Archiguiana and the Andes. Such inability to cross even moderate seas would be strong evidence that they could not have crossed the Atlantic, and that there must have been continuous land, or land at frequent intervals or better still, a land wave carrying the families common to Africa and South America from a center to both these continents.

The fact that the Pacific slope fauna is generically all but identical with the Atlantic slope fauna, and that the latter is generically different from the African fauna, makes it certain that the Pacific slope fauna was derived from the Atlantic slope fauna long after Guiana was separated from Africa.

VIII. THE NECESSITY AND EVIDENCE OF A FORMER LAND CONNECTION BETWEEN AFRICA AND SOUTH AMERICA.

Not a single species of South American fresh-water fishes is found in North America, nor do any North American species reach South America. Two prominent South American families, the *Characidae* and *Cichlidae* have representatives as far north as the Rio Grande basin, and one of these has succeeded in crossing over into Cuba, evidently from Yucatan; on the other hand, several members of the North American fauna have representatives as far south as the Isthmus of Tehuantepec. The North American fauna is entirely distinct from the tropical American fauna.

But four genera of fresh-water fishes of South America north of Patagonia are found in any other continent than North America. These are *Synbranchus*, *Agonostomus*, *Cotylopus* and *Fundulus*. The first is found also in brackish water, the second belongs to the marine family *Mugilidae* and the other to the *Poeciliidae*. *Synbranchus* (map, p. 354) is found in India, *Agonostomus* in Middle America, West Indies, northern South America and New Zealand, Australia, Celebes, Mauritius and Comoro Islands. There is no reason why *Agonostomus* may not have been independently evolved in the South Sea and in America from marine mugilids.

Cotylopus is found in Central America and Reunion Island, Africa, *Fundulus* in America and Europe.

It is possible that *Pimelodus* is found in Africa, and *Pseudauchenipterus* in Madagascar. Both are found in South America.

Tropical Africa and Tropical South America have two groups of families



Range of the Petromyzontidæ.



Range of the Galaxiidæ.

TO ILLUSTRATE THE ORIGIN OF THE SOUTH AMERICAN FRESH-WATER FISH-FAUNA.

in common. The first group comprises the *Serranidæ*, *Sciænidæ*, *Mugilidæ* and *Tetraodontidæ*.

These are all marine families, some of which have also developed fresh-water forms in Europe and North America as well as in South America. The fresh-water forms of South America and Africa are local adaptations



Range of the Haplochitonidæ.



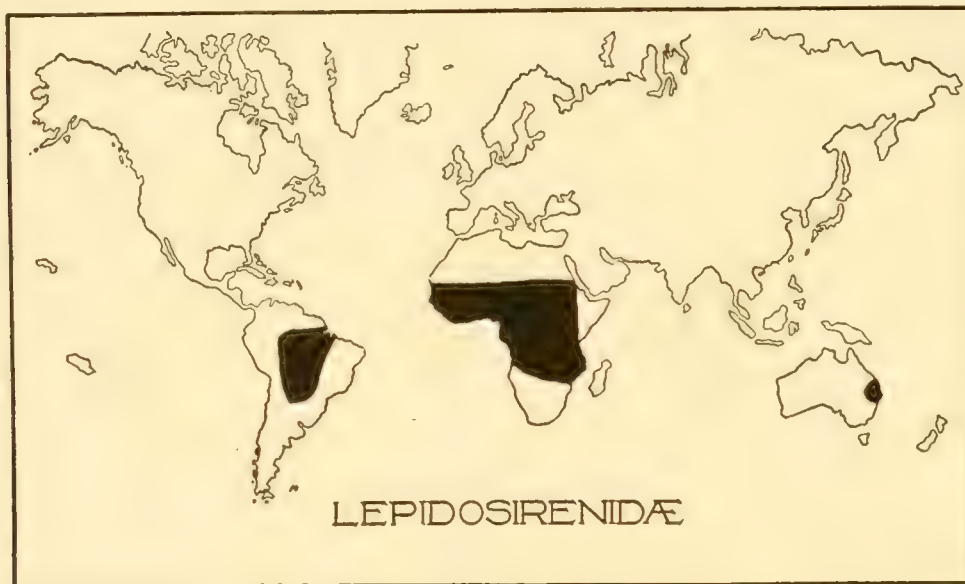
Range of the Synbranchidæ.

TO ILLUSTRATE THE ORIGIN OF THE SOUTH AMERICAN FRESH-WATER FISH-FAUNA.

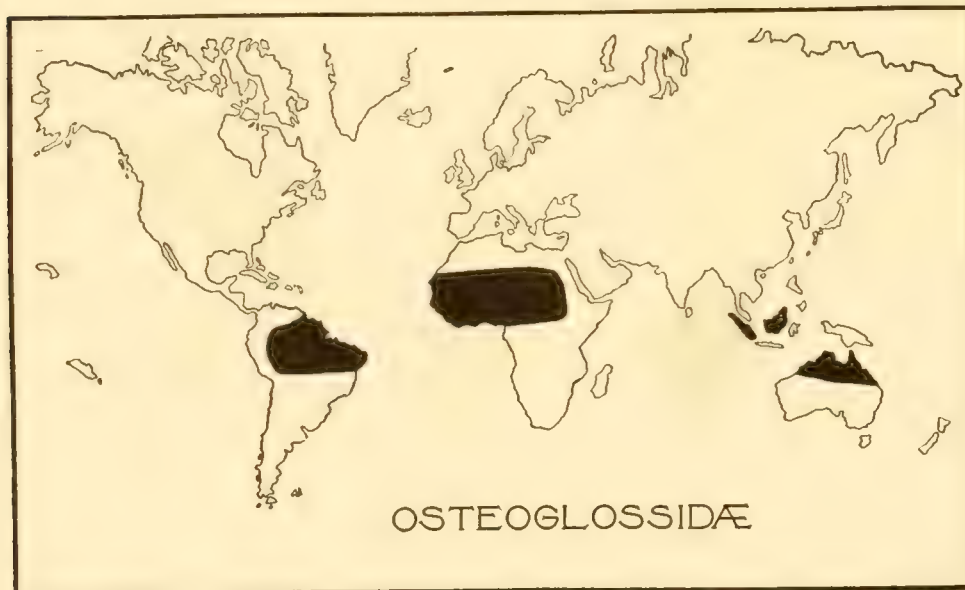
of marine families that require no change in the present conditions to account for their origin.

The second group comprises the *Lepidosirenidæ*, *Osteoglossidæ*, *Siluridæ*, *Characidæ*, *Pæciliidæ* and *Cichlidæ*.

Of these, the *Lepidosirenidæ* are relicts of a formerly widely distributed group, and it requires no land connection satisfactorily to account for



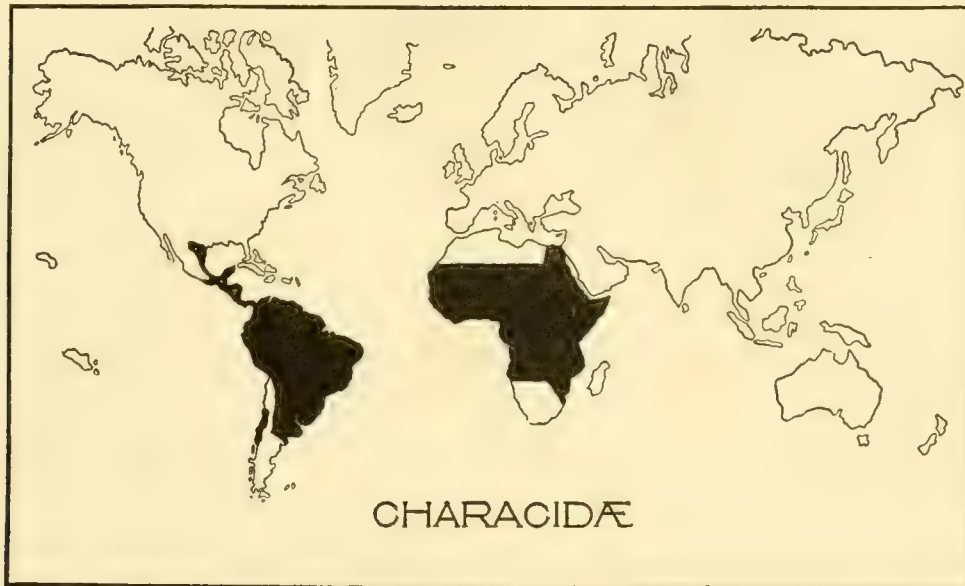
Range of the *Lepidosirenidæ*.



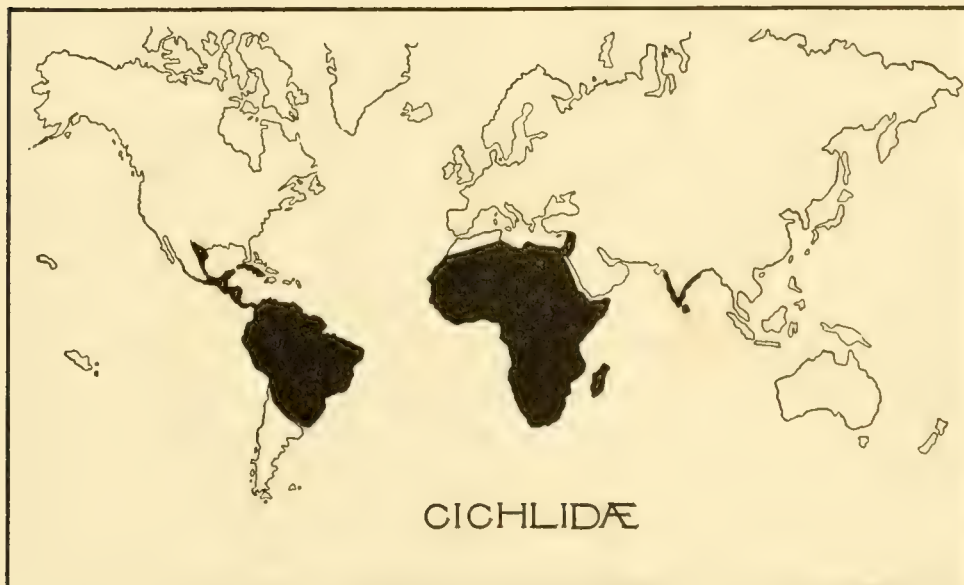
Range of the *Osteoglossidæ*.

TO ILLUSTRATE THE ORIGIN OF THE SOUTH AMERICAN FRESH-WATER FISH-FAUNA.

their presence in Africa and South America. The *Pæciliidæ* live indifferently in marine, brackish water or fresh water. They reach their maximum development in the fresh waters of Mexico, the West Indies and Central America. The marine species are found along the shores—not at sea—and there is, therefore, at present, no known means of getting



Range of the Characidæ.



Range of the Cichlidæ.

TO ILLUSTRATE THE ORIGIN OF THE SOUTH AMERICAN FRESH-WATER FISH-FAUNA.



Range of the Pæciliidæ.

TO ILLUSTRATE THE ORIGIN OF THE SOUTH AMERICAN FRESH-WATER FISH-FAUNA.

them from the American to the African shore. Nevertheless, *Fundulus* is found on both sides of the Atlantic, and there must have been an intermigration much more recent than the youngest possible land connection between Africa and South America, or else there has been a very long persistence of this genus. A land connection, while not absolutely required for this family, would be very convenient.

The *Siluridæ* are in part marine. All of the South American forms of *Siluridæ* can be derived from the marine *Tachisurinæ* and the same is probably true of the African members of the family. Furthermore, the catfishes are found in North America, Europe and Asia, and have been recorded in North America also from the Tertiary. A land connection between Africa and South America is, therefore, not absolutely required to account for their presence in both continents, though, as in the case of the *Pæciliidæ* such a connection would be very convenient.

The *Cichlidæ* and *Characidæ* are abundant in tropical America and in Africa, a few species of *Cichlidæ* being also found in India. There is no known means by which these two forms could have crossed the existing gap between Africa and South America. There has been no exchange of species in recent times, for there is no species or genus common to the

two continents. The South American and African elements of these two families must have been derived from some intermediate land-mass or must have gone from one continent to the other over a land bridge. That this connection, whatever it was, must have been obliterated before the Tertiary, is evidenced by the facts that the Tertiary deposits of Taubaté and Parana show existing genera and that there are many South American types, as the *Gymnotidæ*, *Electrophoridæ*, *Bunocephalidæ*, *Loricariidæ*, *Argiidæ*, *Pygidiidæ*, *Callichthyidæ*, *Hypophthalmidæ*, et al., not found in Africa, that have all arisen in South America from the *Characidæ* and *Siluridæ* since the separation of the two continents.

Similarly, other families found in Africa and not in South America have either arisen in Africa since that time or have immigrated from the East.

A land connection, whether a land bridge, intermediate continent or land wave between the two continents, is imperative. This land connection must have existed before the origin of existing genera and before many of the existing families.

On the other hand, Boulenger (Les Poissons au Bassin du Congo, VIII) explains the similarity of the South American and African faunas as "without doubt the result of the persistence in these two parts of the world of types more generally distributed at a very remote epoch which have disappeared in other regions, as palæontology shows us, among others, to be the case with the Dipneustes, which belong to this category.

"Nothing is gained by explaining these similarities by interpolating a hypothetical continental continuity which could not have existed except at a time previous to the development of the groups of teleostean fishes which Africa and South America possess in common."

IX. THE POINTS OF ORIGIN AND LINES OF DISPERSION OF TROPICAL AMERICAN FRESH-WATER FISHES.

The study of the distribution of fresh-water fishes has led to these general conclusions.¹

The origin and distribution of the fresh-water fishes of tropical South America has come about as follows:

¹ It has been sufficiently emphasized in the first section of this report that the fauna of "Archiplata" or Patagonia is not related to or contains but a few intrusives from the Tropical American Fauna.

In the earliest Tertiary tropical America consisted of two land areas, Archiguiana and Archamazona, separated by the lower valley of the Amazon which was still submerged.

There was a land mass between Africa and South America—possibly in contact with Guiana in South America and some point in tropical Africa. This land mass was inhabited, among others, by *Lepidosirenidae*, *Pæciliidae*, *Characidae*, *Cichlidae* and *Siluridae*. This land mass sank beneath the surface of the ocean, forcing the fauna in two directions, towards Africa and towards South America, exterminating all types not moved to the east or the west. From these two rudiments have developed the present diverse faunas of Africa and South America, each reënforced by intrusives from the ocean and by autochthonous development, by immigrants from Africa, also neighboring land areas. The one fauna cannot be said to have been derived directly from the other.

The connection between Africa and South America existed before the origin of present genera and even before the origin of some of the present subfamilies and families, some time before the earlier Tertiary. There has never been any exchange between Africa and South America since that time. There must have been an intimate connection between these two continents, for there is no evidence, such as identical species or genera on the two coasts, to indicate an occasional or accidental exchange of types across the Atlantic since the formation of existing genera, therefore, such an interchange across the ocean probably never took place. The East Brazilian land mass south of the Amazon (Archamazona) must have become stocked from the western end of Helenis (Archiguiana) very early, for it contains many genera peculiar to the region, indicating a long separation, and Tertiary fresh-water deposits in this area contain existing genera of fresh-water fishes. The Pacific slope fauna is a more recent acquisition from the east.

When, later, the Cordilleras arose out of the ocean at a distance from Archiguiana and Archamazona too great to be traversed by colonists from them, their developing streams and arms of the sea, connected with brackish, and later fresh-water lakes, all became populated with marine types from the surrounding sea. In the north where they came in competition with immigrants from Archiguiana, most of them were exterminated with the continued elevation of the land. On the south which was not or was not so early reached by immigrants, *Orestias*, *Gastropterus*,

BASE MAP OF SOUTH AND MIDDLE AMERICA



and *Protistius* remain in the high Cordilleras of southern Peru as relicts of these marine species. Later, these mountain streams, especially those of Ecuador and Colombia, became populated by stragglers or accidental visitors from the land areas to the east. These in their turn, with the elevation of the Andes, became modified and gave rise to the genera now peculiar to both slopes of the high Andes, *Pygidium*, *Eremophilus*, *Chaetostomus*, *Arges*, *Cyclopium*, *Astroblepus*, etc.

With the further elevation of the Cordilleras into a continuous barrier and the formation of the Orinoco, Amazon and La Plata valleys through elevation and the debris brought from the land masses, and the development of the enormous fresh-water system occupying these valleys, this system, particularly the Amazon, became colonized from the older land areas and became the center of unparalleled adaptive radiation and a new center for distribution, which it has remained to the present time.¹ The comparatively few types inhabiting the old eastern land masses found themselves in possession of a continent and diverged along every conceivable direction, the characins alone giving rise to over 500 species and over 100 genera.

From the Amazon species moved in all directions till they met barriers of one sort or another. The Pacific slope fauna is derived to a very large extent from this latter divergent migration over the isthmus of Panama and through the Atrato valley between the western and coast Cordilleras of Colombia. Others possibly crossed over the Andes east of Guayaquil before the Andes reached their present height. The Pacific slope fauna is less different from the Amazon fauna than that of the coastwise streams of Minas, if the number of peculiar genera is used as a measure of difference. Amazonian types moved south till climate and barriers checked them south of Buenos Aires. They migrated northward till they came in competition with emigrants from the north in the lowlands of Mexico.

The origin of the fauna of the plateau of Mexico is a separate subject. This fauna is in part of marine origin and antedates, in a large measure, the mongrel fauna of the Mexican lowlands.

¹ Amazonian species form six or seven per cent. of the fauna of the Motagua, five of the Pacific slope fauna, over 30 per cent. of the Magdalena fauna, over 42 per cent. of the Trinidad fauna, over 50 per cent. of the fauna of the Guianas, over 40 per cent. of that of the San Francisco, about 30 per cent. of the fauna of the coastwise streams east of the San Francisco, and over 50 per cent. of that of the Paraguay.

Evidence for these conclusions has been given in detail in the foregoing pages. The basis for the entire discussion is a list of the species giving their geographical distribution. Such a list has been prepared and follows this discussion.

The points of strategic importance for ichthyic chorology in South America are, therefore, (*a*) western Colombia and Panama; (*b*) Guayaquil and Peru to the Amazon, across the Andes; (*c*) the tableland of Guiana, Archiguiana; (*d*) the Rio San Francisco, with the Rio Parahyba and the headwaters of the Tieté and Rio Grande, in Archamazona, and (*e*) the area between the Rio Negro and the La Plata.

NOTE ON LAKE TITICACA AND ITS FAUNA.

In conversation with Prof. G. Steinmann the latter called attention to his views concerning Lake Titicaca, which he had the kindness to write out for me.

"The region at present covered by Lake Titicaca was formerly, as late as late Tertiary times, a normally drained area. Its drainage was south-east toward the Amazon. It was not till the Glacial epoch that the glaciers of the high Andes pushed their moraines into the drainage valley and formed the lake. It is, therefore, a glacial-dam lake which did not retain its Amazonian drainage, but flowed over the low watershed southeast toward the undrained high plateau of Bolivia. There is no evidence that the lake was formerly connected with the Pacific. Not only are there no marine formations in the inter-Andean high plateaus of northern Bolivia and southern Peru belonging to the Diluvial time, but also those of Tertiary times are lacking. For this reason also the fauna of Titicaca cannot be explained as a relict, but must have arisen from the ocean by migration in a roundabout way through former rivers and lakes."

In my account of Lake Titicaca it was assumed that the origin of the lake from an arm of the sea was without question, and an attempt was made to explain its fauna on that basis. It was assumed that the genus *Orestias* gave rise to numerous species, some of which succeeded in crossing the divide into neighboring rivers. The explanation of Steinmann would obviate the difficulty of originating numerous species from one type in a restricted unit environment. General observation everywhere gives evidence that segregated individuals of a given species tend to diverge from the central type, not that a species mutates into a large or

small number of species in a restricted locality. It seems as reasonable to assume that *Orestias* migrated from the ocean into all streams when the Andes were low, became different in these segregated environments, and filtered from them into Lake Titicaca, as to assume that it became landlocked in an arm of the sea when that was cut off by elevation, gave rise to numerous species in the one locality, and migrated from the lake to the headwaters of neighboring streams.

THE FAUNA OF THE RIO REBEIRO.

During the years 1907 and 1908 a series of papers on the fishes of the Rebeiro by Rebeira and the Cubatao by Steindachner have shown that these isolated rivers have a fauna, nearly half of which is peculiar. They are streams in the northern part of the state Sta Catharina emptying into the Atlantic. The material came too late to incorporate in the proper table without entirely resetting it. A list of the fishes from these rivers is, therefore, given here. This peculiar fauna, situated between Rio Grande do Sul of the La Plata province and the Parahyba of eastern Brazil, demonstrates very well that the streams emptying into the Atlantic do not form a highway for ready migration from the North or South.

Peculiar species are marked *, peculiar genera †.

- * *Hemipsilichthys calmoni* Steindachner. Cubatao.
- † *Kronichthys subteres* Rebeira.
- Parotocinclus maculicauda* Steindachner.
- † *Otocinclus leucofrenatus* Rebeira.
- † *Otocinclus gibbosus* Rebeira.
- Loricaria latirostris* Boulenger.
- * *Loricaria henselii* Steindachner. Cubatao.
- Loricaria lima* Kner.
- † *Loricaria cubataonis* Steindachner. Cubatao.
- Loricaria anus* Valenciennes.
- † *Xenocara brevispinnis* Regan. Cubatao.
- Ancistrus stigmaticus* Eigenmann & Eigenmann.
- † *Harttia kronei* Rebeira.
- Plecostomus commersoni* Valenciennes.
- † *Plecostomus obtusirostris* Steindachner. Cubatao.
- Trichomycterus dispar* Tschudi.
- Trichomycterus brasiliensis* Lütken.

- * *Trichomycterus proops* Rebeira.
Glanidium albescens Reinhardt.
Pseudopimelodus zungaro (Humboldt).
Pimelodus clarias Linnæus.
- * *Rhamdella ignobilis* Steindachner. Cubatao.
Rhamdia sebæ Cuvier & Valenciennes.
- * *Rhamdioglanis transfasciatus* Rebeira.
- † *Typhlobagrus kronei* Rebeira.
Heptapterus mustelinus (Valenciennes).
- * *Hoplias lacerdæ* Rebeira.
Curimatus gilberti Quoy & Gaimard.
Characidium fasciatum Reinhardt.
Astyanax scabripinnis (Jenyns).
? *A. microcephalus* Rebeira.
- * *Astyanax scabripinnis longirostris* Steindachner. Cubatao.
Astyanax fasciatus (Cuvier).
- * *Astyanax eigenmanniorum depressirostris* Rebeira.
- † *Deuterodon iguape* Eigenmann & Norris.
- † *Deuterodon rosæ* (Steindachner).
- † *Hollandichthys multifasciatus* (Eigenmann & Norris).
Pseudochalceus perstriatus Rebeira. *Pseudochalceus affinis* Steindachner.
- † *Cæturichthys iporangæ* Rebeira.
Acestrorhynchus hepsetus (Cuvier).
januarius Hensel. Cubatao.
- Pæcilia vivipara* Bloch & Schneider.
- Geophagus brasiliensis* Quoy & Gaimard. Rebeira & Cubatao.
- Cichlasoma facetus* Jenyns.
- Cichlasoma autocthon* (Günther).
- Crenicichla lacustris* Castelnau.

EXPLANATION OF PLATE XXX.

Fig. 1. *GEOTRIA CHILENSIS* Gray. From a specimen in the British Museum, natural size.

Fig. 1*a*. Mouth of the same, $\times 2$.

Fig. 2. *GEOTRIA STENOSTOMUS* Ogilby. After Plate.

Fig. 3 and 3*a*. *GEOTRIA AUSTRALIS* Gray. After Plate.

Fig. 4 and 4*a*. *EXOMEGAS MACROSTOMUS GALLEGENSIS* Smith. Figure by Oesterberg after Smith.

Fig. 5. *CARAGOLA MORDAX* Richardson. After Plate.

Fig. 6. *CARAGOLA LAPICIDA* Gray. After Plate.

Fig. 7. *CARAGOLA ACUTIDENS* Philippi. After Plate.

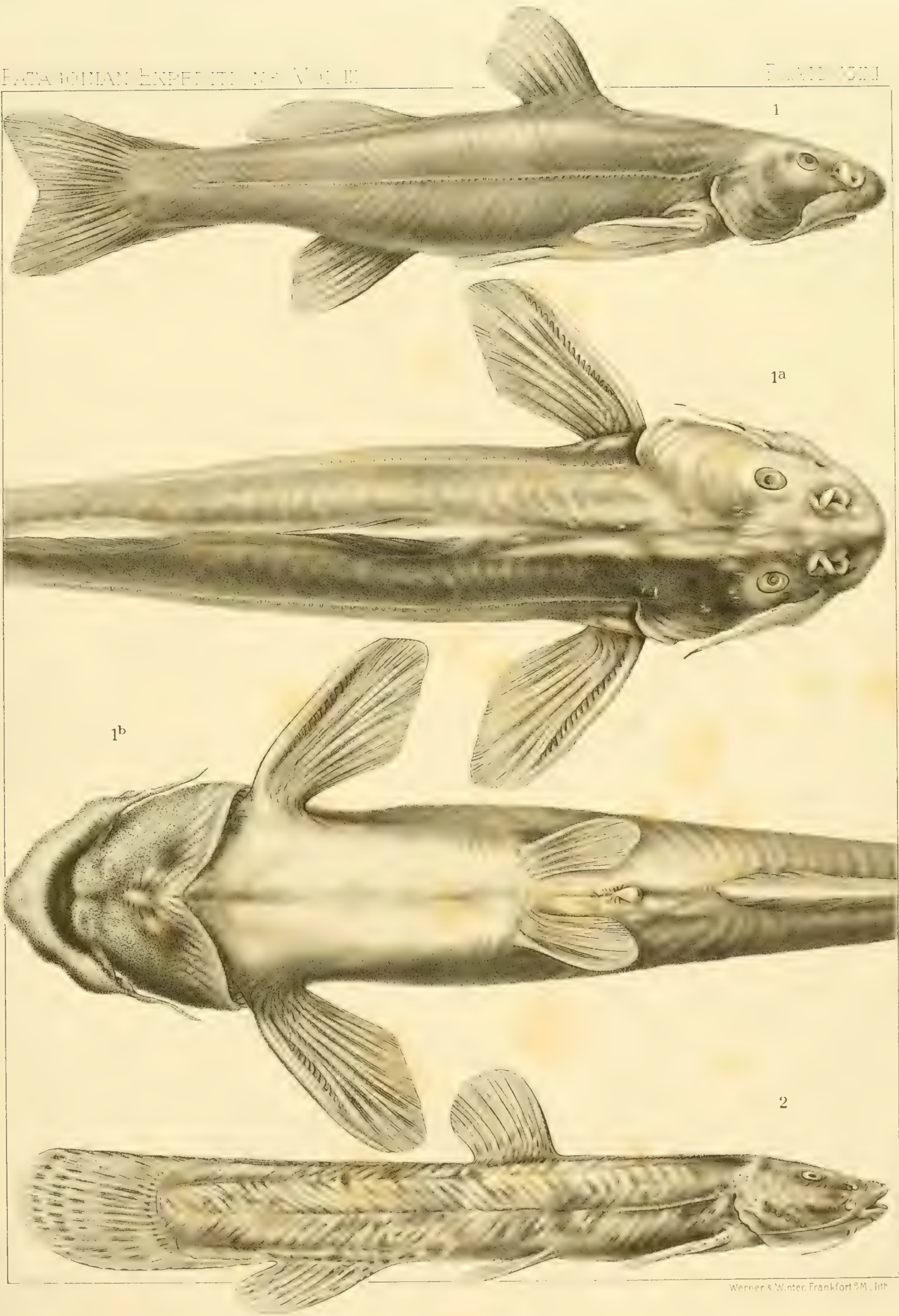


PATAGONIAN EXPEDITIONS: ZOÖLOGY.

EXPLANATION OF PLATE XXXI.

Figs. 1, 1*a*, 1*b*. DIPLOMYSTE PAPILLOSUS C. & V., No. 8290 in the Mus. Comp. Zool. Cambridge, Mass., from Santiago, Chili.

Fig. 2. NEMATOGENYS INERMIS (Guichenot). No. 9839 Mus. Comp. Zool. Curico, Santiago, Chili.



Werner & Winter, Frankfurt a. M., lith.

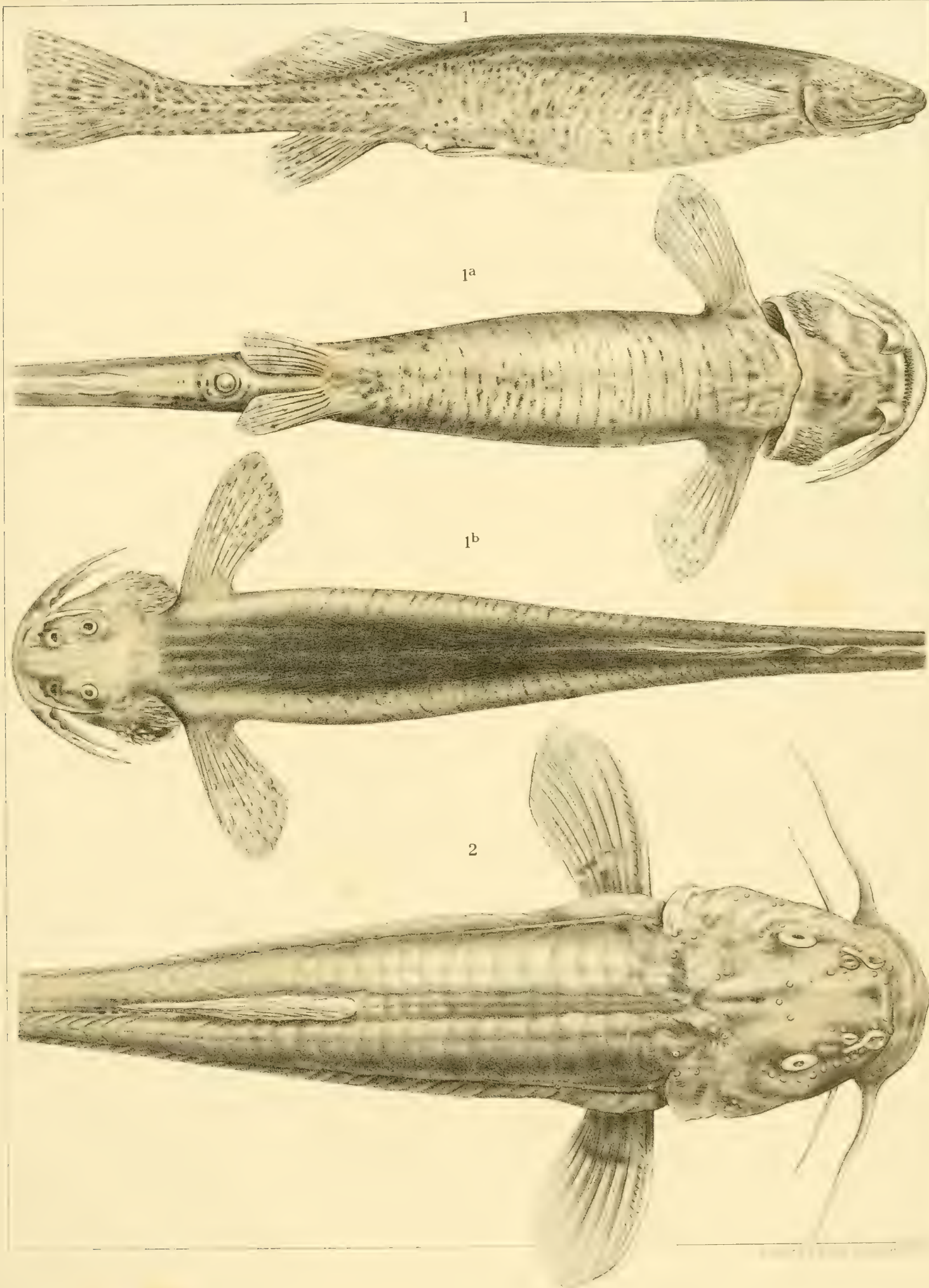
DIPLOMYSTE & NEMATOGENYS

PATAGONIAN EXPEDITIONS: ZOÖLOGY.

EXPLANATION OF PLATE XXXII.

Figs. 1, 1*a*, 1*b*. *HATCHERIA MACRÆI* (Girard). No. 8298 Mus. Comp. Zool.
Uspullatuo, Chili.

Fig. 2. *NEMATOGENYS INERMIS* (Guichenot). See plate XXXI, fig. 2

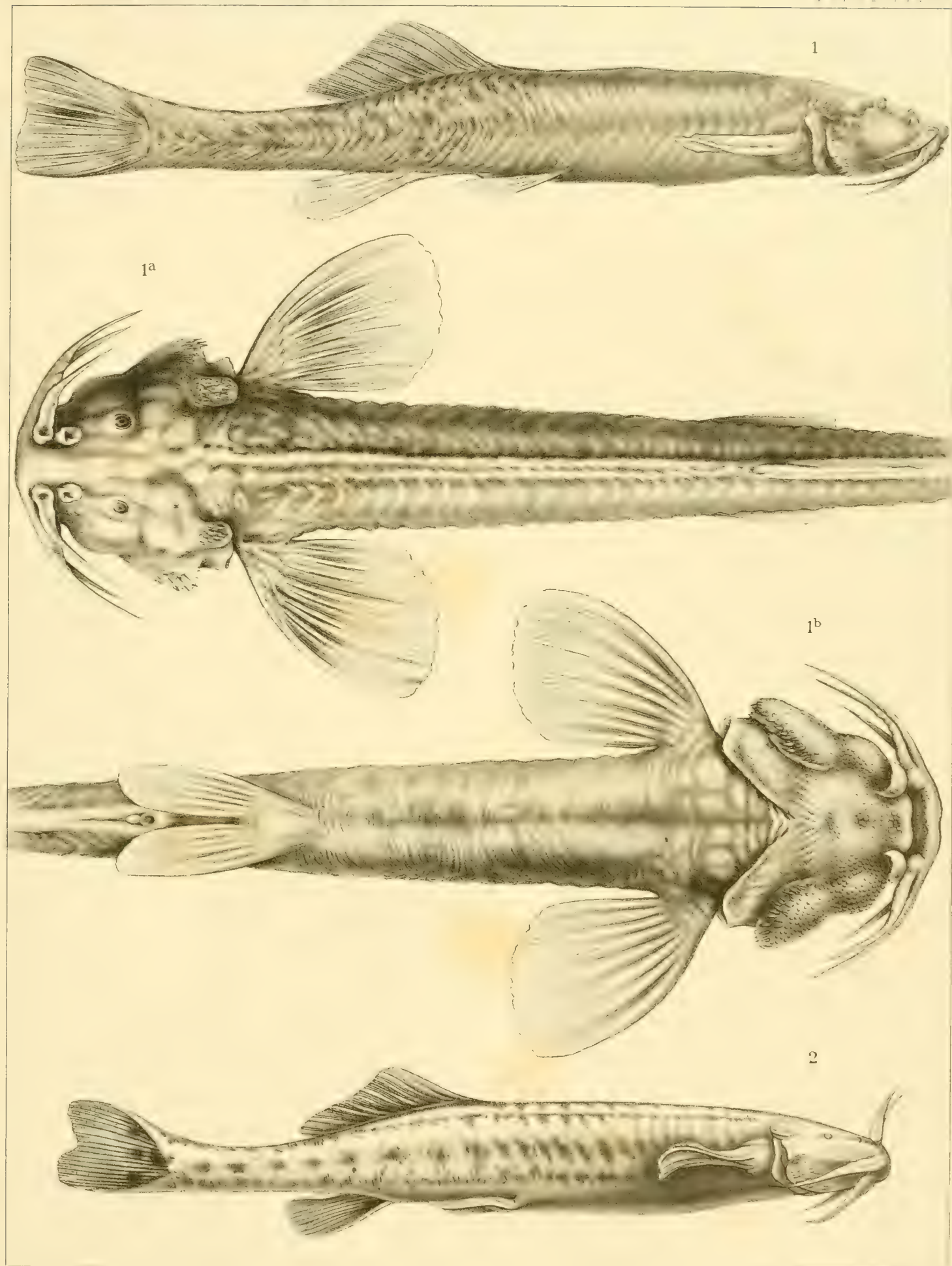


HATCHERIA & NEMATOGETTIS

PATAGONIAN EXPEDITIONS: ZOÖLOGY.

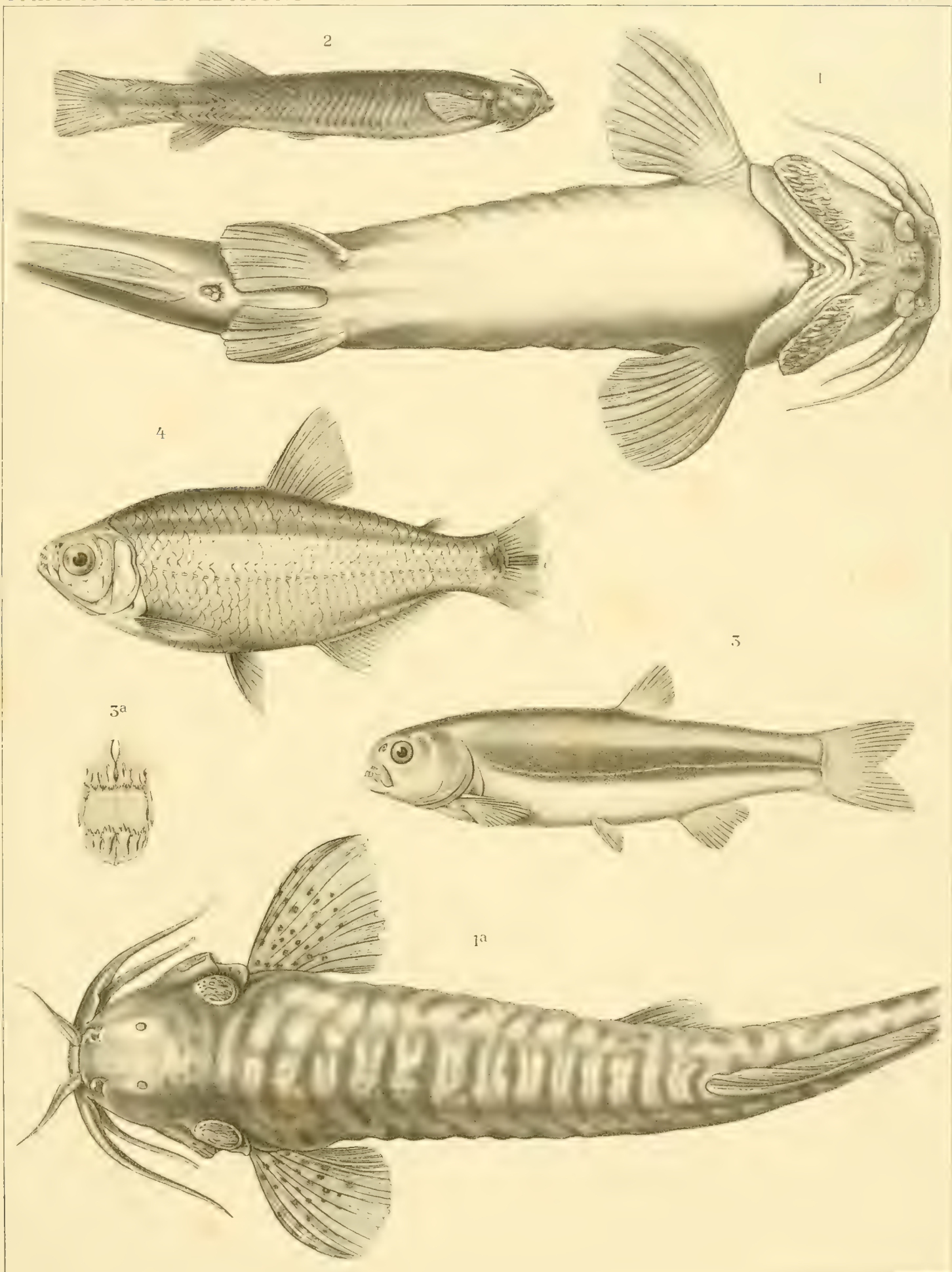
EXPLANATION OF PLATE XXXIII.

- Fig. 1, 1*a*, 1*b*. *HATCHERIA MACULATA* (Cuvier & Valenciennes). No. 7736
Mus. Comp. Zool., Mapocho, Chili. Total length 92 mm.
Fig. 2. *HATCHERIA PATAGONIENSIS* Eigenmann. Rio Blanco.



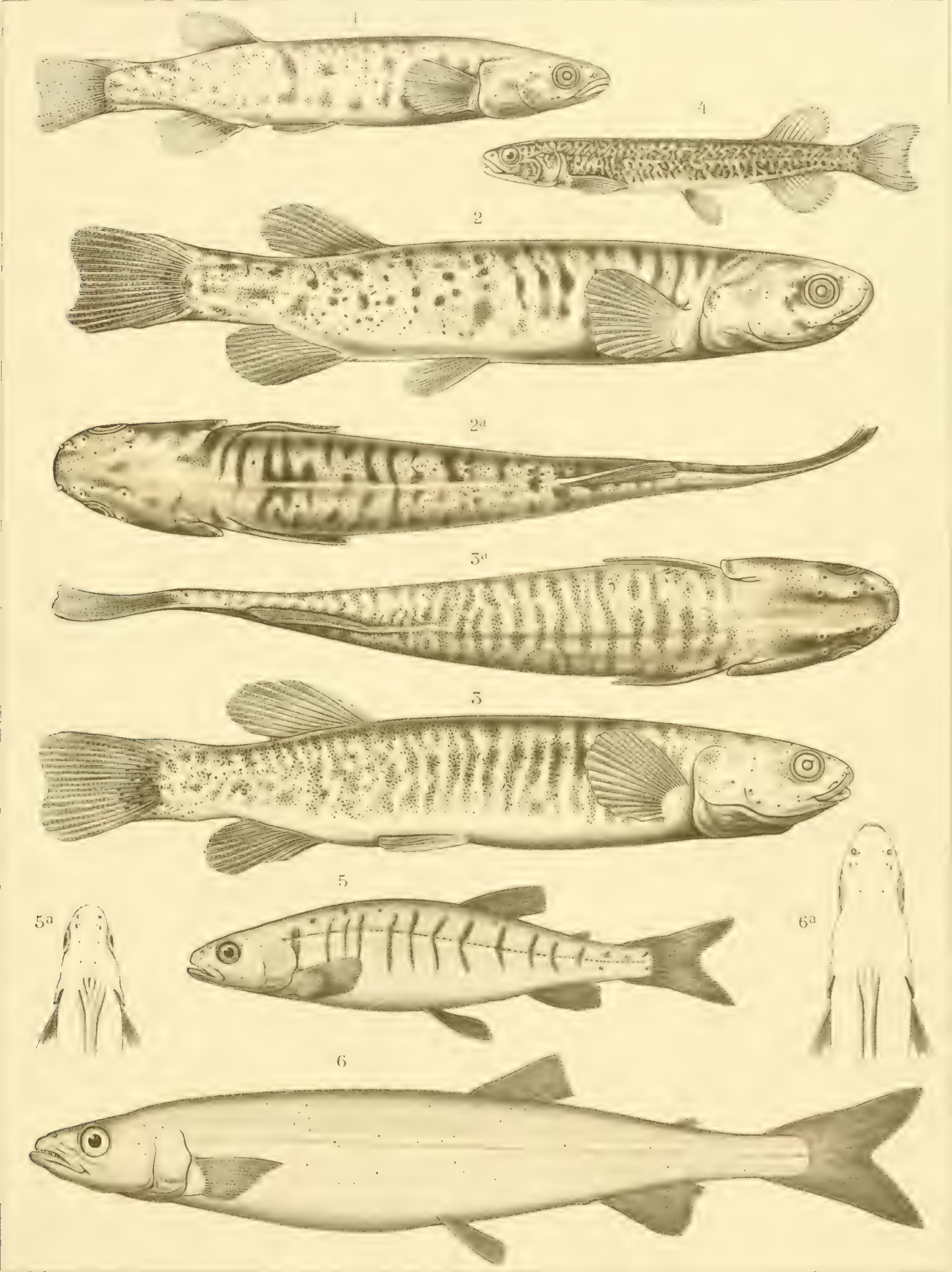
EXPLANATION OF PLATE XXXIV.

- Fig. 1. *HATCHERIA PATAGONIENSIS* Eigenmann. See plate XXXIII, fig. 2.
Fig. 2. *HATCHERIA AREOLATA* (C. & V.). Mus. Comp. Zool.
Fig. 3. *GYMNOCHARACINUS BERGII* Steindachner. After Steindachner, $\times 3$.
Fig. 3*a*. Dentition of the same.
Fig. 4. *ASTYANAX RUTILUS* (Jenyns). Drawing by J. Green from a specimen from the Rio Negro in the British Museum.



EXPLANATION OF PLATE XXXV.

- Fig. 1. Side view of a young specimen of *Galaxias alpinus* (Jenyns).
Figs. 2, 2*a*. A larger specimen of the same.
Figs. 3, 3*a*. Another specimen with different color pattern.
Fig. 4. *GALAXIAS MACULATUS* (Jenyns). From a specimen in the British Museum.
Fig. 5, 5*a*. *APLOCHITON ZEBRA* Jenyns. After Smith.
Fig. 6, 6*a*. *APLOCHITON TÆNIATUS* Jenyns. After Smith.

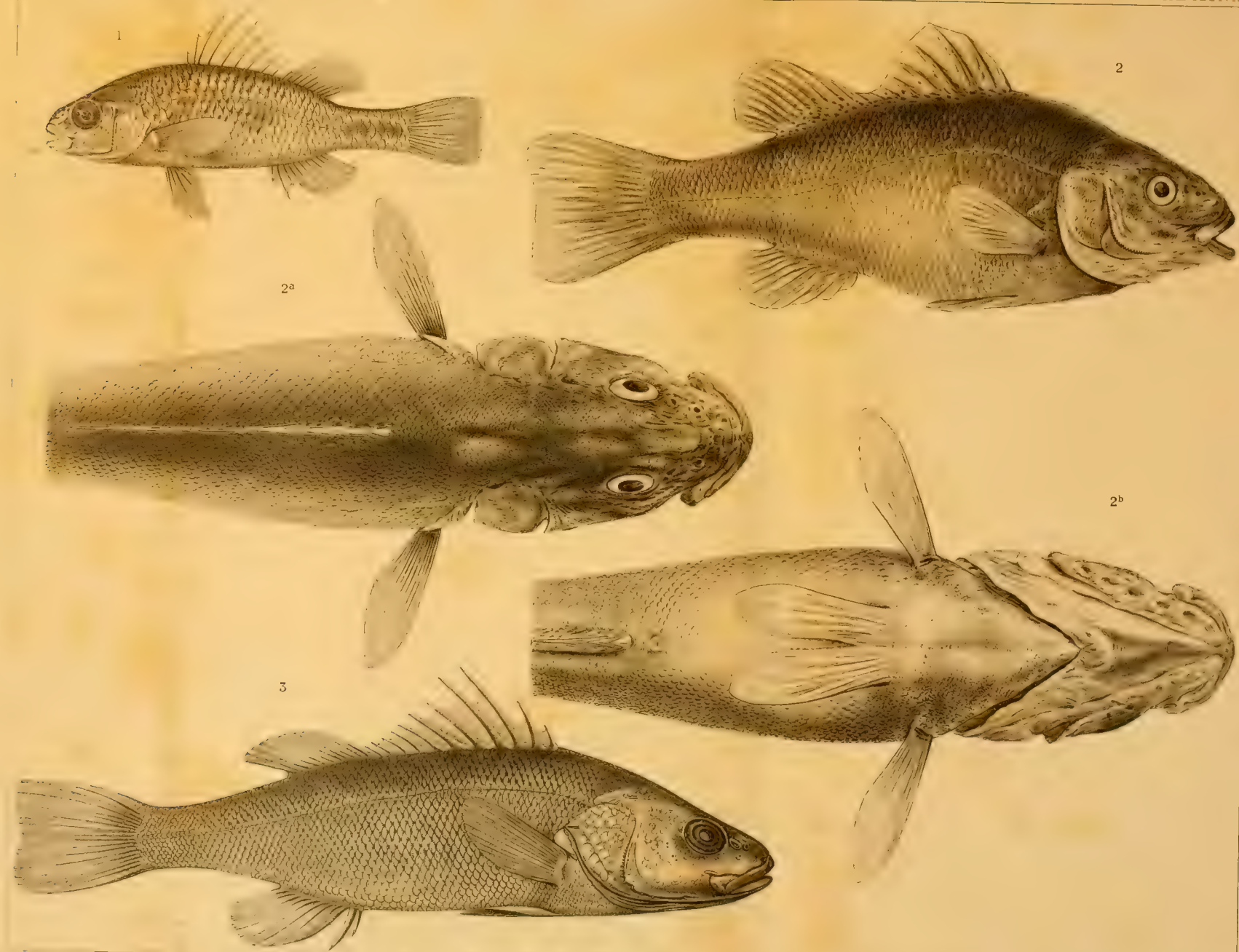


EXPLANATION OF PLATE XXXVI.

Fig. 1. *PERCILIA GILLISSI* Girard. From a specimen in the British Museum.

Fig. 2, *2a*, *2b*. *PERCICHTHYS MELANOPS* Girard. No. 4835 Mus. Comp. Zool.,
Curico, Chili.

Fig. 3. *PERCICHTHYS TRUCHA* (C. & V.).



Wagner & Winter, Frankfurt a. M. lith.

EXPLANATION OF PLATE XXXVII.

- Fig. 1. PERCICHTHYS ALTIPENNIS (Regan). After Regan.
Fig. 2. PERCICHTHYS TRUCHA C. & V.
Fig. 3. PERCICHTHYS VINCIGNERRÆ (Perugia).
Fig. 4. MENIDIA HATCHERI Eigenmann.

